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THE EYE

IN ITS RELATION TO HEALTH

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BY

CHALMER PRENTICE, M.D.

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A. D. 1895

NEW THEORIES THAT ARE TRUE, MEET ALL THEIR OPPOSITION FROM THOSE WHO MISUNDERSTAND THEM

THE EYE

IN

ITS RELATION TO HEALTH.

I.

A CRITIC is one who is skilled in judging of the merits of a work. He must be a connoisseur; he must be an adept, before he is able to pass judgment of high value.

In this work many ideas are set forth that are entirely new. Many tests are suggested that may seem strange, and results recorded that appear incredible, but the value of these tests can not be determined without thorough investigation. Viewed from the standpoint of our earlier professional teaching and experience, the position I assume may seem to be wrong; yet careful investigation as directed in this work will perhaps prove that new methods will produce new results. Some months or even a year and more ought to be spent in the experiments suggested in this work, for many of the changes sought are, at the best, slow, and the conditions with which we deal are at times obstinate and deceptive.

After investigation, I invite criticism. "Truth

is mighty and will prevail." This is the one sustaining thought to one who presents anything new to the world; and for appreciative and valuable criticism of this work I turn to those only who are possessed of careful, discriminating, strong, individual judgment, and whose conclusions are always based on a thorough investigation of facts.

However extensive the experience of any oculist may have been, I do not expect from him full concurrence in my opinions as a result of that experience; and any judgment from that plane I shall deem in a great measure unfair; but from such a source, after careful consideration of the methods I have suggested, I do expect concurrence, or, at least, fair criticism.

A perfect judgment can not be fairly arrived at by reading only a part of this work, for questions might suggest themselves on one page which would be satisfactorily answered by a continuous and careful perusal of all the pages.

A subject like the present, pointing toward advancement in the field of medicine, is too sacred to be trifled with by casual and inexperienced criticism; but all honest inquiry regarding my methods I will cheerfully answer, hoping thereby to advance medical science.

I fully realize that many of the following statements may seem incredible; but they can all

be practically demonstrated by carefully conducted tests in any suitable clinic, which is the only place in which to decide a question of so important a nature. Under suitable conditions, I shall be pleased to make these tests at any time.

There seems to be little, if anything, left to discover concerning the laws of refraction in their application to defective vision. Helmholtz, Donders, Landolt and many others seem to have solved nearly every problem in matters of refraction and the application of glasses for correction of the same. Many ingenious methods have found their way into use for determining, both by objective and subjective examinations, the artificial aids to produce the most perfect vision. The acquisitions in this field are the result of many years of careful investigation, through all of which the tacit assumption has been, that, when the eye was so corrected and the function of vision at once more easily and perfectly performed, all that could be desired had been accomplished. Here is exactly where the greatest error has existed; and it has lain so deeply hidden that it is not entirely strange that it has remained so long undiscovered. What misled us to the greatest extent was that, when the function of vision was perfectly performed, we rested in the belief that the eye was perfect; but it did not occur to us that some eyes might be using an excessive amount of nerve-

impulse to bring about and sustain that perfect vision.

Long years of effort are made by defective eyes to perform the function of vision as perfectly as possible. When necessary, the nerve-centers innervate to their utmost power the various eye muscles, causing a change of shape in the crystalline lens, stretching muscles which were too short and shortening muscles which were too long, to enable the eyes to look in the same direction. These conditions are continued, and more or less sustained, from day to day through a period of many years. Thus, anatomical parts that were manifestly imperfect at birth meet with changes in shape that become more or less established, so that it is impossible at once to discover and correct the same by fitting such glasses as produce the most perfect vision. Such a procedure is often incorrect, inasmuch as it stimulates the maintainance of abnormal conditions that, as soon as possible, ought to be discovered and corrected. When all the facts are carefully considered, we can readily see that we may have more or less firmly fixed conditions, which will only recede gradually and thus permit the eye slowly to assume a normal state.

In a slight measure, the discovery of the action of atropine, hyoscyamine, and similar drugs on the eye, has taught us that the first manifest

conditions that present themselves to us in latent hypermetropia are not what they seem. For instance, a spasm in the ciliary muscle often hides a great measure of the defect, making the eye appear more perfect than it really is. Similar hiding power may exist in any of the other ocular muscles and deceive us as to their true conditions. It is for this reason that many people experience great and repeated trouble in their endeavors to have their vision properly corrected. They pass on and on from one professional man to another, receiving from each a correction that proves but temporary ; and yet it is probable that each correction was made scientifically and fulfilled all needs that the eyes manifested at the time of each examination. Every oculist has had his troublesome cases of this kind.

The reason why greater uniformity of opinion has not existed concerning treatment through the sight centers, is that our observations have been confined to more or less manifest defects, and these at best represent but a very small percentage of the disturbing conditions that may exist in the ocular apparatus. Defective eye muscles, which tend to cause the eyes to deviate from a normal position, were tested by various methods tending to destroy the fusion stimulus ; but these methods discover only a very small percentage of the existing abnormal conditions. The great ma-

jority of disturbing causes are not to be found in manifest defects of muscle balance. Some of the most serious conditions exist where the muscle balance is apparently perfect, the defect being a fixed abnormal innervation which is sustaining a perfect position of the eyes, and which continues to maintain it under all tests that rely on the artificial disturbance of fusion power (diffusion tests).

Further than this, in a large share of those cases where the deviations are manifest, the eyes are turned in exactly the opposite direction to that in which anatomically short muscles would turn them. For instance, a right eye with a short superior muscle, instead of being drawn upward, might tend downward to a considerable extent by the force of spasm. The nerve-impulse sent to the inferior muscle to enable it to hold the eye down level with its fellow, becomes, through resulting irritation, more than is necessary, and pulls the eye down beyond a balance; so that the opposite eye will be the higher of the two under the diffusion test, because the abnormal impulse is permanent. It can readily be seen that the usual correction of an eye manifesting this reverse condition would prove injurious instead of beneficial. I have spoken at length elsewhere on this class of cases; adverse results in them are strong reasons why we have not attained a more general

success. Such results have failed to make the treatment impressive, and from the very nature of these cases as set forth in this work, it will be seen how unreliable any and all of such tests are, however complete and perfect their destruction of fusion power may be.

Again, eyes that are capable of prominently manifesting their defects are more or less at rest when not in constant use, whereas absolutely latent eye troubles find no such periods of relief. It is from the latter and the reverse class that the most serious nervous disturbances take their rise. The correction of MUSCULAR INSUFFICIENCY or manifest irregularity must not be confounded with the idea of REPRESSING ABNORMAL INNERVATION. One is not a modification of the other, nor do they bear the slightest resemblance to each other, though both methods of treatment are through the medium of the eyes ; and it would be as foolish to confound them with each other for this reason as it would be to confound various schools of medicine because the remedies are applied through the medium of the mouth.

Eye-strain, or excessive abnormal innervation of the eye muscles, depletes the nerve-centers. It also gives rise to brain irritation of varying degrees. Dispositions are altered by it; character is forcibly changed; mental faculties are impelled into channels of work that are anoma-

lous. Into such an altered state these conditions may force a being as to make him appear to the world an entirely different character from what he otherwise would have been. So, if in time these disturbing conditions can be corrected, we may expect to see favorable changes in the physical, mental and moral parts of the individual.

Some very remarkable cures have followed the correction of defects in and about the eyes; in fact, so wonderful have some of these changes been, that to the novice it seemed absolutely incredible that anything in connection with the eye could have been the real cause of the change; and, naturally, he turned in some other direction to account for the facts which were too stubborn to be denied. Generally what is called "mental-suggestion," in some of its forms, has been settled upon as the cause of these changes. Some persons have more or less belief in the efficacy of suggestion, or they would not turn to it as such a potent cause; but suggestion as a curative power has been known under various names for ages. Gasner, a priest of Bavaria, was said to have worked some remarkable cures by laying on of hands. Hell, of Austria, claimed a wonderful healing potency in the magnet. Mesmer took his cue from the preceding claimant, and evolved what has been known for a century as mesmer-

ism. About the close of the last century, the French Academy appointed a commission to investigate the principles involved in Mesmer's work. Benjamin Franklin was a member of that commission. The decision arrived at was, that whatever effects were produced were of a temporary character, and due entirely to suggestion. Hypnotism and braidism are simply other names for practically the same influence. There are other methods of more modern birth that owe whatever efficacy they possess to suggestion. I think all careful observers are ready to admit that there is considerable influence in suggestion, both for good and for evil, especially on weak, nervous people. The evil effect will prove the greater and more lasting of the two.

However potent suggestion may be, it has never been an aid to curative results through the medium of the eye; on the contrary, it has been the most detrimental element in the way of its advancement. Suggestion is more effective in the shape of ridicule than any other form of its administration, for it is easier to depress than to elevate a failing life; and such we have frequently seen sacrificed to the potent evil influence of suggestion. The strongest evidence of the true value of treatment through the eye is the fact that it has made all of its advancement through a storm of opposition and ridicule, the only argu-

ments of the unenlightened. Suggestion cannot be said to have had any influence in lunacy and other states of lost minds that have been influenced and restored by eye treatment. Prisms in a certain position often relieve pain, and when reversed increase it; yet the suggestion is equally potent in either position.

It is common and natural to cling to a belief in things and methods that have long been established, and in which leading men and authors concur; and, if the results of such following are universally perfect, more cannot be desired. But, when they fall far short of satisfaction, we are warranted and even impelled to search outside of established authority for the aid that it fails to give; otherwise, science and art would never advance.

II.

NO part of the living body is constructed in vain. Every minute portion has some particular office to perform. However simple or however complex any one of these parts may be, it is so constructed as to facilitate the work that it has to do. Each distinct part may be looked upon as a little engine which is put in motion by the application of the motive-force that enables it to perform its function. This motive-force is conveyed from the place where it is generated, through conductors called nerves, to the part where the function is performed; and, like the running of an ordinary engine, the character of the function is determined by the character of the motive-force supply. If the proper amount of steam is admitted to perform the function of the engine, the work is properly and evenly done. If too much steam is turned on, the engine runs too rapidly and is likely to do itself injury by over-work. If too little is applied, the running of the engine is very feeble and can be stopped by the slightest interference. If the steam is cut off entirely, the engine stops. Here we have a perfect analogy to all functions in the human or animal body. If

the motive-force is just adequate to the necessities of the part, the function will be normal; but, if the motive-force is in excess, the function will be erratic and unnatural, exhibiting disturbances which will be classified as some disease of the part, which will be of an active nature. If the motive-force is lacking in quantity and regularity, the result will be that the function will be very feebly performed, and some sluggish, indolent condition will follow, which will be classified as an inactive, indolent disease. These changes, which are similar in all parts, can be easily noted and demonstrated in the action of the heart. In a state of perfect health, the nerve-centers are furnishing and sending to this little engine, impulses of motive-force which give rise to a regular, unvarying beat of about seventy impulses to the minute. Now, if the nerve-centers be excited in any way, the heart's action at once will manifest the change. A cry of fire, a terrific explosion, or the sudden consciousness of some important news of good or bad import, causes an excitement of the nerve-centers in which the supply of nerve-force is temporarily increased, and a larger amount than usual traverses the various nerves throughout the entire system. The heart's action becomes violent and rapid, manifesting the exact amount of change of motive-supply from the nerve-centers to the heart. We note the changes of action par-

ticularly in the heart, whereas the fact is, every function in the whole body is equally affected, but the change is not so manifest to our observation; nevertheless, the alteration of function everywhere in the body is equivalent to the change in the motive-force supply. The nature of the function, whether it be normal or erratic, is a manifestation of the character of the motive-force supply, really giving us a perfect idea of the condition of the nerve-centers from which the force is proceeding. This would naturally lead us to the conclusion that ALL ALTERATIONS OF FUNCTION ARE PRIMARILY CENTRAL IN THE NERVOUS SYSTEM.

Every organ in the body has special organic work to perform. Likewise, the various tissues of which the organ is constructed have functions to perform. Every little living cell, be it bone, nerve, muscle or any tissue, has a function to perform called assimilation. A cell of adipose or fat possesses the power to attract to itself carbon, hydrogen, and oxygen, or matter of its own kind, in just the proportions of which the cell is composed, and in quantity just sufficient to maintain the proper size of the cell: surrounding the cell is the cell wall structure, which is doing a separate work by drawing to itself matter of its own kind, but in different proportions to the cell within: again, adjacent to this is a cell of muscle, bone,

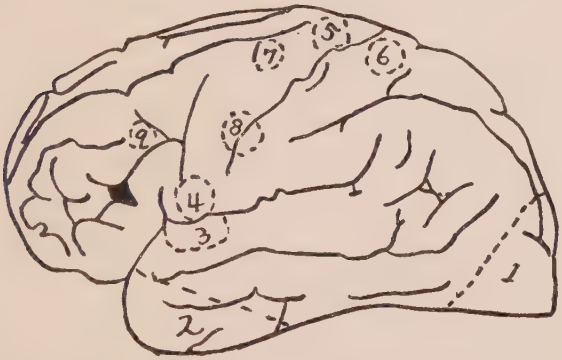
periosteum or other structure, each attracting differently unto itself elements of its own kind, in just the proportions that each needs: and so on throughout all the various structures of the animal economy. These are all separate little functions.

The blood is simply a carrier of the food from which all the elements of the body derive their sustenance; but it does not perform the multiple function to select, for the many cells of various kinds, their individual complex requirements. Each individual cell possesses the power to select by its polar forces that which it requires; and these forces are generated and sustained by nerve-impulse.

Each separate and individual part or organ of the animal economy has some special place or center in the nervous system that presides over it; some specific center where is generated the motive-force that performs the function of the part over which it has control; and the manner in which the part does its work determines for us the condition of its motive center. A very few of these nerve-centers have been located; yet a sufficient number to assure us that each function has, somewhere in the nerve-centers, a special place that is generating and sending forth that force which does the work.

We may look upon the brain as a series of dynamos that are constantly generating motive-

force, and sending it out over the various conductors that we call nerves, which convey it to the place where the work is done. This force polarizes the cell structure, which then performs the work of attraction and repulsion.



1. Visual centers.
2. Taste, smell and sexual feeling (centrally located).
3. Hearing.
4. Face, tongue and speech.
5. Complicated movements of hand, arm and leg.
6. Coarse leg movements.
7. Coarse arm and leg movements.
8. Coarse arm movements.
9. Writing images.

When the liver, kidneys, heart and other organs continue to perform their various offices in a healthy manner, the inference is that the motive-forces are being furnished accordingly; but, whenever any of these organs begin to perform unnatural offices—generating abnormal secretions such as sugar, uric acid, etc.—we infer that abnormal motive impulses have supervened.

NORMAL SECRETIONS ARE THE OUTCOME OF NORMAL FUNCTIONS PERFORMED BY NORMAL IMPULSES.

ABNORMAL SECRETIONS ARE THE OUTCOME OF

ABNORMAL FUNCTIONS PERFORMED BY ABNORMAL IMPULSES.

Each class of secretions is dependent on its characteristic motive-force. In other words, when a function becomes abnormal, it is not the part or engine that is at fault, it is always the motive-impulse which is responsible for the erratic work. For, even if the part itself through local irritation or injury, is caused to change its action, it even then does it by first sending the irritation to the presiding nerve-center, which reflects the impulse that causes the change.

When a bone is broken, the first natural, local changes that follow are pain and inflammation, which occur as follows: From the point of irritation caused by the fracture, an impulse is sent to the nerve-centers that preside over the part. They return their characteristic impulses to the place of injury, which at once establishes an inflammatory action at the place of rupture; and this action involves the manufacture or formation of those products or elements needed to repair or heal the part. These are new, temporary functions. Without this communication from the injury to the nerve-centers and the corresponding return current, the fractured ends would never become reunited nor the injury repaired.

I have in mind a case of a railroad employe who was under my care some twenty-five years

ago. Both bones in the lower part of the leg were broken and protruded through the skin. The fractured ends were properly adjusted. In a general way, he was an unhealthy man, with a very weak nervous system. After several days, the patient remarked to me, "I think you are a very good doctor for I have no pain in my leg." I said, "My dear fellow, that is just what does not suit me. I prefer that you should have some pain and inflammation." But it did not follow. For one hundred and forty days, I tried all the various methods known to get up an irritation in the part, after which I first discovered symptoms of the broken ends reuniting themselves. In this case, the delay resulted from the weak condition of the nerve-centers and their inability to respond by sending back to the injured part the proper nerve-impulse to establish the inflammatory action of repair. Never can work or function be performed without the appropriate application of some motive-force to perform it.

However brilliant an inventive genius may be in all other directions, he begins to lose his reason when he searches after perpetual motion, or a piece of machinery so constructed as to possess in itself the power to do the work or perform the function. Such an unfortunate genius generally ends his life in a lunatic asylum. As in mechanics, so in animal life, all effects have a cause.

III.

SIGHT is not passive, it is an active function; and, although we see apparently without effort and without volition, yet every moment of vision is costing its adequate amount of vital energy. True, we cannot say just how much energy is utilized in looking any given length of time at any particular scene; but we do know that many nervous persons are very much exhausted by the use of the eyes for a short time in an art gallery, where things of great interest are constantly attracting their attention. Some are more exhausted by one hour of such effort with the eyes than they would be by ten hours of manual labor; consequently the same amount of vital force that would be required for ten hours of labor, may be disposed of in one hour through the medium of the eyes. Now, if there be some defect in the construction of the eyes, the consumption of nerve-force will be much greater; for example, a short superior muscle in one eye requires many times the amount of nerve-force to perform the function that the centers were ever intended to furnish. The function of sight may be as successfully performed as if the eyes were perfect,

but only by an excessive call on the nerve-centers to maintain a balance between the two eyes; in such cases the vision is sometimes of more than average sharpness. This extravagant waste might find a good parallel in the following: An electric plant is scientifically constructed for the purpose of running fifty arc lights; each light utilizes a given amount of electric force that is generated at the electric center, and the fifty lights just use up what force the dynamo can easily generate. Now, in the place of one of these arc lights, if we place an electric motor which uses twenty times as much force as the light that it has displaced, the whole electric system will be disturbed, from the fact that the electric motor is utilizing more than its share of the motive-force; consequently the other forty-nine lights in the circuit will not receive enough to perform their intended functions; they will sputter, burn irregularly and feebly. We have here a state of affairs in our arc light system which may be likened to that form of nervous debility where the prominent feature is constant exhaustion, due to a lack of sufficient force of nerve-impulse. But in the animal economy, another condition may follow when the "dynamo" is over-taxed; the nerve-centers may be excited to an irritable condition in which they generate an excessive amount of nerve-force, and then we

have an excited or agitated form of nervous derangement; and, whether it be general or localized, it soon wears out life.

Strictly construed the terms neurasthenia and nervous debility mean a weak or depressed nerve-force supply. They are sometimes carelessly applied (but are not properly applicable) to all nervous derangements; for we often meet with nervous derangements that consist of an excessive supply of nerve-force, usually accompanied with more or less irritability, all functions in general being emphasized. The enormous assimilation in abnormally fat persons, and the excessive muscular development and activity in a class of phenomenal athletes, whose histories are short and generally end in some rapidly wasting disease, are extreme examples of that form of nervous derangement which consists of an excess of nerve-force supply and which should be called *neurosthenia.* The term ABNORMAL-INNERVATION embraces both of these conditions.

Our fast ocean steamers can run nineteen or twenty miles an hour without excessive consumption of fuel; but when the speed is raised to its highest possibilities, the last two, three or four miles are attained at a very extravagant increase in the fuel, the consumption being far greater in proportion per mile as well as resulting in a great strain throughout the ship. A ship is

sometimes unable to sustain the highest tension that can be put upon her by her engines, in which case the good engineer turns off the excess or abnormal quantity of steam, slows her speed to an easy pace, and thus her life in the waters is lengthened many years. Likewise when we learn that some of our functions are being performed at an abnormally high tension requiring an extravagant amount of nerve-force to sustain them, which is rapidly wearing us out, we should suspend this high rate of function and conserve as far as possible our life forces, by removing the cause of the irritation and waste.

The nerve-centers are capable of generating a certain amount of motive-force or nerve-impulse and no more. Whenever the call upon the centers exceeds their ability to respond, the result is a disturbance somewhere. A large amount of motive-force is utilized in the function of vision even when it is performed under the easiest possible circumstances; but when there are defects in the eye and its appendages, there is a still greater demand for nerve-force to bring about good vision.

Each nerve-center is intimately connected and in delicate sympathy, with all other centers of the nervous system. Any radical change in one center sends its characteristic influence throughout all.

Harmonious and pleasant sounds, picturesque scenes filled with things of beauty, loveliness and goodness, have the most marked influence over the nerve-centers in general and manifest themselves in the form of the body, the grace of movement and the sweetness of expression in the features. Such external influences have a tendency to produce, through the medium of vision, the perfect man and woman ; whereas the one who is reared amid scenes of crime and brutality, coarseness and privation, is so influenced in his whole physical being that, to the experienced eye, their marks are everywhere to be seen.

The reason husband and wife grow to look alike after living years in each other's company is, that they have looked so constantly upon each other's features, have been made glad by the same influences, have enjoyed the same sunshine, have met with the same sorrows and have been so often subjected to the same experiences, that their functions have become similar.

Now what particular portion of the nerve-centers should we expect to have the greatest influence in changing and controlling the general nervous system? Would it be one of the duller centers, or would it be the most acute and sensitive? We would reasonably look to the most sensitive as bearing the highest influence both for good and evil.

Of all the centers in the nervous system, which is the most sensitive, the most highly acute and the most constantly in use?

The answer is, that center in which the most positive impression is made by the lightest and most delicate touch or impact. Various parts of the body, for instance, the fingers, come in contact with a substance; immediately there is an afferent impulse communicated to the nerve-centers that says, 'this is velvet, fur, wood, metal, hot or cold.' Again, substances of different flavors are taken into the mouth. When they come in contact with the nerves of taste (gustatory nerves) the afferent impulses from this contact convey to the nerve-centers the consciousness of the presence of lemon, orange, vanilla, etc., and the reflex of swallowing or deglutition follows. If the flavor be something which conveys to the nerve-centers a disagreeable or nauseous taste, the opposite reflex follows, and an effort is made to reject the offensive material instead of swallowing it.

The auditory center discriminates in all the delicate sounds known to music, in all the varieties of harmony and discord. The potent influence of music on the feelings of man and beast is well known.

Another sense equally or more delicate, is that of smell. The perfumes emanating from helio-

trope, violet and other flowers can neither be weighed, measured nor analyzed, being so delicate and imponderable; yet, the sense of smell produced by them is of a very positive nature.

As delicate as the above named senses are, there is yet another of a much more highly acute nature; in fact, by far the most delicate sense of all, sight.

Light is imponderable; its rays, reflected from various objects, pass through the cornea, the aqueous humor, the crystalline lens, the vitreous body, and there reach the retinal nerves. The delicacy of this touch or impact on the retinal nerves is beyond the conception of the human mind; yet it establishes from this point an impulse which is conveyed to the visual or sight centers of the brain, which with no uncertainty, determines form, color, motion, quantity, and space. Here we have the most positive sense or feeling known to man; sight, produced by an impact or touch of the most imponderable agent or force known to science. There is not an impression, feeling or sense with which the nerve-centers have ever been made familiar which is not in some measure reawakened through the visual apparatus.

The musician runs his eye over the page of written music, and he hears it. One sees a person across the street eating a lemon, and he tastes it.

The salivary glands begin to act ten rods away from the lemon. We see a person's foot run over or crushed, and we feel the wound. It produces changes throughout the observer's nervous system, nausea results, and often so forcible is the effect that unconsciousness follows. Through this medium, mothers have communicated deformities to their offspring by changes in the nerve-impulses that control the function of construction or building. There are many substances which we cannot recognize by the sense of touch, but which sight determines for us at once, showing that the visual nerve-centers are the most sensitive of all.

It is through the feelings awakened by sight that in reading a book and looking at its illustrations, we are enabled to live in the very atmosphere of the scene that is depicted and to drink and satiate ourselves to the fullest extent, feeling, tasting, smelling and hearing the various things and surroundings that the author suggests.

If the light of a single candle is sufficient to produce a perfect impression of a given object in the visual centers, say a letter A, there is a feeling produced in the nerve-centers that tells us of the presence of a letter A. If twice the light that is necessary is reflected from this letter A, twice the impact or impression that is necessary is conveyed to the visual centers and they are taxed to a

double capacity. Should this light be increased to twenty candle power, where one would be sufficient, the visual centers will receive an impulse twenty times as strong as necessary to produce the function of seeing the letter A, or whatever object the eye may be resting upon, and the feeling of sight is over-taxed and disturbed; for sight is nothing more or less than feeling. This excessive amount of useless work even in a normal eye wears on these delicate centers beyond necessity, and they become centers of irritation and convey disturbed conditions to other parts or centers of the nervous system. I touch a person on the shoulder gently; this performs the function of attracting his attention. Again, if I were to use a club and strike a severe blow, the attention would be attracted, but the force of the impact would be more than necessary and an injury to the part would be the result. It is the same with the delicate sight centers. Just a sufficient amount of light to perform the function is all that is required, but a flood of enough force can be admitted to practically bruise these delicate parts of the nervous system. Since the advent of electric lights which have practically turned night into day, there has been an increase in nervous disturbances, due to over-taxation of the visual centers of the nervous system. We turn our eyes in the direction

of hills, valleys, rivers and woods, and the light reflected from the various objects passes into the eye and touches the nerves of sight. From here an impulse is conveyed to the sight centers of the brain and here we feel the form, size, color and motion of the various objects in the scene.

The feeling of harmonious sounds in the auditory centers is enjoyable for the space of two or three hours, but a continuance beyond this length of time becomes tiresome, and the same sounds repeated for five or six hours would be annoying. These centers become temporarily exhausted or worn out.

The feeling of taste when eating the choicest delicacies, in a short time, perhaps an hour, becomes wearied, temporarily perverted, and beyond this time enjoyment ceases. The gustatory centers refuse to be further taxed.

The feeling of smell through the olfactory centers is very delightful for the first few inhalations of some delicate perfume; the sense of smell is at first prominent, but after a few moments the odor seems to excite no feeling at all. Nothing but the pungent feeling of alcohol at last is present. From over-work the olfactory centers have suspended their functions.

The feeling in the visual centers commences at seven o'clock in the morning and continues

until ten o'clock at night. For fifteen hours continuously, more or less, the feeling in the visual centers has been constant. No other sense in the nerve-centers is capable of such continued endurance.

For good or for evil, according to their character, the senses of feeling, taste, smell, hearing and sight have all a marked influence both on our mental and physical lives. Sounds of harmony, delicacies of wholesome and pleasant taste, odors that delight and please the sense of smell, and scenes of beauty, all have an elevating influence over our mental and physical lives tending to a refinement of both mind and body; while the opposites of these experiences produce an unfavorable or opposite effect throughout.

"Why was the Grecian a poet and philosopher, while the Scythian was a wanderer and robber? One was reared amid surroundings of beauty and culture, the other had a barbarian land, rude as his manners and wild as his heart.

Again I repeat, THE VISUAL CENTERS ARE THE MOST SENSITIVE AND MOST CONSTANTLY TAXED, BECAUSE THE MOST CONTINUOUS AND POSITIVE FEELING IS PRODUCED BY THE IMPACT OF AN IMPONDERABLE AGENT. The touch of only a subdued ray of light gives rise to a feeling which is the most certain and continuous of all functions of feeling.

As to the anatomical location of the nerve-centers generally, it will have to be a matter of speculation, because an immense amount of research prosecuted by able men has located only a few of them. Victor Horsley in his work on "The Brain and Spinal Cord" says: "Personally, I believe that anatomical research will do less than physiology toward settling these important and most difficult questions, and that as a fact, we shall not advance very far towards their solution until we are able to approach them from the standpoint of their functions, which of course is a totally different mode of comparative investigation." Also, "Anatomy is not able to adduce absolute evidence either as to agreement or disagreement in the evolution of the structure, it is likely that the physiological aspect of the case is the more correct one."

From a physiological standpoint, there would appear to be a great number of visual centers in the nervous system. When rays of light are reflected from an object and focussed in each eye, there is a strong effort of the two eyes to fix themselves in such a position that the picture made or reflected on the posterior part of each eye shall be in corresponding localities. A ray of light falling exactly on the most sensitive center or yellow spot of the right eye, stimulates through the nerve-centers, a tendency to fix the

left eye in such a position that a ray of light emanating from the same point will also fall upon the most sensitive center or yellow spot in that eye. The same tendency prevails throughout the field of vision. If an eye is fixed on an object, it will be possible to see other objects for quite a distance in various directions without moving the eye; for instance, objects upward as far as 45 deg. can be seen, outward over 90 deg., downward about 70 deg., inward 55 deg. to 60 deg., according to the prominence of the bridge of the nose. To define an object as having form, it is necessary that several impressions be received in the nerve-centers simultaneously or nearly so. The average acuity of vision is said to be an angle of one minute. The top of a letter E falls on a portion of the retina that conveys an impression of its existence, also the tongue of the letter and the bottom of it; the upright portion and the two spaces between the tongue and the upper and lower parts, fall upon separate portions of the retina, each of which takes a distinct impression, and their relative positions are noted by separate and distinct sensory centers in the brain; consequently we feel the form of the letter E. If it were a single sensory center that these distinct and separate objects were conveyed to, it would be a single confused impression. So, from a physiological

standpoint, we see that each minute point in the posterior part of the eye or field of vision is susceptible of taking a separate impression, and has somewhere a distinct sensory center in the nervous system. In looking directly in front of me, I see a red light off to the right, because rays emanating from it have fallen on that portion of the field of vision that conveys its impression to that particular center in the brain that locates it, and always does locate any object falling upon it, to the right of the optic axes; and so it is with each minute and separate locality throughout the entire field of vision. When we contemplate the numerous objects that may be distinguished without moving the eye, we may conceive how numerous must be the sensory centers for the function of vision. At least one for each angle of vision.

When the two eyes are fixed so that rays of light falling from a given point are reflected on corresponding localities in the field of vision, a single impression of the object ensues, because each of these corresponding points is supplied with a nerve-filament that leads to a common or single sensory center; but when rays coming from the same point fall on different or non-corresponding localities in the two eyes, they necessarily meet with nerve filaments originating from two different sensory centers, and each eye conveys an impression of the same object to dis-

tinctly separate centers, and two impressions of the same object are the result. Always, under such conditions, there is a strong effort of the two eyes to fix their optic axes parallel so that the two apparent objects may be fused into one, thus avoiding confusion, and increasing the sense of vision. In doing so, the various muscles act as follows: Let two imaginary lines bisect each other at right angles, one horizontally and the other vertically, and we shall have a cross. Now, suppose the eyes to be out of visual line so that a dot will appear to the right eye to be in the lower right hand corner of the space occupied by the cross, and that to the left eye the same object will appear in the left upper portion of the cross. These impressions simultaneously seen with both eyes will appear as two dots. To merge or fuse these two impressions of the dot into one, the external and internal muscles move the eyes laterally until they are in such a position that the two dots are brought to the imaginary vertical line of the cross. One will now be above the other. This we call the tendency to VERTICALIZE exerted by the internal and external rectus muscles; while at the same time, the superior and inferior rectus muscles move the eyes upward and downward to such a position that the dots are brought to the imaginary horizontal line. This we call the ten-

dency to HORIZONTALIZE. The vertical and lateral muscles in accomplishing the above movements, receive some aid from other muscles. This is explained at length elsewhere. These tendencies to horizontalize and verticalize being exerted simultaneously, bring two impressions of a dot to the center of the cross, merging them into one object. In this position, rays emanating from a single point fall on corresponding localities in each eye, and are conveyed to a single visual center producing the impression of one. The superior and inferior oblique muscles also play their part in the rotations of the eyes, so that rays from a single point may fall upon corresponding localities. The above process is called FUSION.

IV.

WE give specific names to disturbances in the various parts or organs of the body, but still they are nothing more than erratic functions, which may be localized in the liver, kidneys, heart, digestive apparatus, lungs or any other part or parts of the animal economy.

Health is that condition in which all the functions throughout are normal in their action. Any departure of a function or functions toward an unnatural or abnormal condition is disease. Disease is the negative of ease and means something uncomfortable or uneasy; but any change of function toward an abnormal condition should be classified as a disease, whether it manifests itself by discomfort or otherwise.

HEALTH IS NORMAL OR HYGIENIC PHYSIOLOGICAL FUNCTION.

DISEASE IS LOCALIZED ABNORMAL INNERVATION AND ALWAYS CENTRAL IN THE NERVOUS SYSTEM, BEING A LACK OR EXCESS OF MOTIVE-FORCE.

Disease may take its origin from a sufficient irritation of any of the nerve-centers, but much oftener will disease find its origin through the most highly acute and sensitive centers.

What is termed organic disease really consists of some lesion of the parts which is the result of continued imperfect or erratic function, and in the true sense lesion is not disease but the result of disease.

The growth of tumors is due to abnormal innervation. In a benign tumor there is an excess of assimilative nerve-impulse which causes the part to gather unto itself more than its proportionate quantity. In a malignant tumor the same condition exists, with the addition that the assimilation consists of gathering to itself heterogeneous elements forming a structure which is alien to the part.

In the study of disease, we have exhausted our fullest resources in searching for causes. We find various lesions, such as deposit, disintegration, hypertrophy, atrophy and heterogenetic conditions, and often have settled upon some of these lesions as being the cause of other accompanying pathological symptoms. This is not true, they are nothing more than accompanying conditions or results of disease. A LESION IS ALWAYS A RESULT AND NOT A CAUSE. It may be the source of a still further reflex disturbance, but back of all of these conditions is abnormal innervation; and from whatever source it takes its origin, it is the first great disturbing cause, in all deranged functions.

The electric current or impulse passes through the cable, under the ocean, conveying intelligence from one continent to another. It moves ponderous machinery of various kinds, it traverses the trolley and moves the heavy car loaded with passengers. Although unseen, we have learned to look upon it as a mighty force, as something that exists, from the fact of the powerful functions that result from its application. In like manner we must learn to look upon motive-force or motive-current in the animal body as the first and most important thing in its very existence, for all things that are done are accomplished through its agency and nothing is accomplished without it.

The intent of this work is to treat of nerve-impulse, its equilibrium or balance in health, and its lack of balance or irregularity in disease. In speaking of eye-strain, I always mean lack of balance in the nerve-impulses of the eyes, and this often exists to a high degree when the muscle balance is apparently perfect.

The defects in the eye muscles may be entirely latent to diffusion tests. I know it is customary when finding small amounts of manifest irregularities in some of the eye muscles to suspect the existence of a still further defect in the same direction, a small portion of which may slowly manifest itself during a long course of treatment; but further than this latent defects have not been

suspected or looked for. The most obstinate cases of localized and general nervous debility are more frequently the result of conditions which are absolutely latent, with no manifest deviation to lead us to suspect their presence. The only thing that leads us to believe that latent eye-strain exists is the nervous derangement of the patient.

Diseases of the eye, like those of the body, are localized abnormal innervation. By examining a few individual cases, we can draw general conclusions which will enable us to individualize any disease of the eye under the theory of erratic function caused by abnormal innervation. Abnormal innervation of the ocular apparatus causes disturbances of the nerve-centers and they are reflexed to the eye, disturbing its nutrition or the impulses that perform its various delicate functions. In cataract, from some disturbing cause, there is a gradual cessation of those vital forces that keep up the nutrition, assimilation and life of the crystalline lens, and it ultimately dies, becomes a foreign, opaque body. In that dreaded and generally incurable disease of the eye, glaucoma, one of the most popular treatments is iridectomy, also division of the ciliary muscle, called cyclotomy. Occasionally these operations have been known to arrest the disease, which, in my opinion, they do only when the glaucoma has been dependent on latent hyperopia or strain in

the ciliary muscle. The iridectomy as well as the division of the ciliary muscle would have a tendency to suspend the tonic spasm or contraction of latent hyperopia, and thus in a measure restore equilibrium in the distribution of nerve-force to various parts of the eye; but, where these operations fail to produce any effect whatever, my opinion is that there may be an excessive strain in some one of the long muscles that is giving rise to the disturbance; and if this is carefully sought out and operative measures resorted to, the improvement will be as certain as in those cases that are relieved by operations affecting the ciliary muscle.

Various forms of inflammation of the eyes are due to disturbances in the nerve-impulses, and a correction of latent eye-strain, in whatever direction it may be found, often acts like magic in relieving these troubles after they have resisted other treatment. If the examination is careful and the operation thorough, rarely will the oculist be disappointed in obtaining good results. Any disease of the eye, other than zymotic or traumatic, and a continuance of even these may depend on eye-strain.

The microbe theory as to the origin of disease is in no way affected by assuming that general nervous derangement, in some cases more or less localized, is the underlying or predisposing cause

of disease in general. If all the organs and parts of the animal economy are receiving a generous and adequate supply of motive-force from the nerve-centers, the functions are necessarily performed with vigor, and the presence of microbes of any character does not prove sufficient to disturb these vigorous functions. They are continued undisturbed by the presence of the microbe, apparently much the same as an engine furnished with a full and vigorous supply of steam would not be perceptibly or materially affected in its movements though a hand were to be placed upon the fly wheel. It is when the various organs and parts of the body are furnished with a minimum motive-force from disturbed nerve-centers, just barely enough force to keep up the function, that the presence of the microbes is sufficient to interfere with the performance of its work. In this case the microbes give rise to the disturbance of certain functions, or to their characteristic disease. The engine in this case is supplied with so little steam that the placing of a hand upon the fly wheel proves sufficient to disturb its normal action. Thus, in a very plain and simple way, are we enabled to account for the immunity of some persons from disease though they have been exposed to infection. Many theories have been adduced to explain this, but it is undoubtedly correctly explained by this theory.

If twenty people were to migrate into a malarious district, some of them would in time succumb to the poisonous influences of the malaria, which would induce fever and ague, bilious, dengue, or some other form of fever according to the nature of the microbe. Some ten would be constant victims of the malaria, while ten of the same company, who breathed the same air and drank the same water, would enjoy perfect health. All take in the poisonous influences in equal proportions; but those of a neurasthenic predisposition will yield to the baneful influence, while those whose functions are perfect and vigorous will be able to live for years without showing that they are in any way materially influenced. It is not, as I have often heard it expressed, that those who do not suffer throw off the microbe; they take it into their systems in the same proportions as those who yield to disease, but their functions are so perfectly and strongly performed, that the presence of the microbe fails to disturb their action.

Viewing all disease as localized nervous derangement, it will not be necessary to enumerate the whole category of ills, but a few prominent ones will suffice, and the same general reasoning can then be applied to all the rest, for disease is not a thing, an entity. We have various erratic, abnormal actions in certain func-

tions of the body, and we give them names. For instance; if a patient has excessive thirst, and the kidneys are secreting a great amount of water, the liver has taken upon itself through erratic action to manufacture larger amounts of sugar than are to be met with in a state of health; we name these functional derangements diabetes mellitus. A large train of other symptoms which vary greatly in different cases will be noted in various forms of this disease, from the fact that the irritation in the central nervous system is so varied in its character that it sends out corresponding impulses which perform erratic work in various parts of the body. Whatever the nature of the erratic function that falls to the liver, spleen, or kidneys, it is entirely due to the character of its nerve-impulses. In diabetes, it is safe to say there is not a function in the whole animal economy that may not be coincidently more or less deranged or erratic; but whatever the nature and train of symptoms, the name of diabetes mellitus will prevail, provided an excessive quantity of urine containing sugar is secreted, accompanied with the usual diabetic thirst. To enumerate and particularize, in all the cases of functional disturbances that might present themselves, would require the space of volumes. The names of diseases are useful, inasmuch as they suggest to the prac-

titioner of medicine, a certain combination of disturbed functions. When an irritation in the nerve-centers arises from injury, it is called traumatic. When it arises from other causes than injury, it is called idiopathic. It makes no difference whether the nerve-centers receive their disturbing cause through the one source or the other, they are still irritated or disturbed nerve-centers; and in either event the position we have taken is in no way altered, that disease is always localized abnormal innervation.

Various forms of catarrh are localized nervous derangements. The inflammation of the mucous membrane of the nose, ear, throat or other parts that are affected, is a result of a pre-existing condition, namely an unnatural or excessive sensibility of this membrane; which simply means that the nerve-centers are supplying this membrane with nerve or motive-force of such a character that it takes offense at very slight changes in the temperature of the atmosphere. Again, the pollen and perfume of flowers sometimes give rise to hay fever, asthma and various forms of catarrh. All this is because the nerve-impulse that is supplying the part is so excessively abnormal in the way of sensibility, that things otherwise inoffensive produce serious results. It is not the nerves that are affected; they are simply conveyors of sensitive nerve-force. They themselves are passive and

without feeling. It is the impulse that passes through the nerves that characterizes the peculiar irritability or hypersensitiveness of the membrane, and this gives rise to the inflammatory action that follows.

Alcoholism is a form of abnormal innervation which manifests itself in an irritable craving for alcoholic stimulus. It is not necessary to dilate on the different forms of drunkenness further than to mention the habitual and the periodic drinker. The habitual drinker has a steady or fixed irritability in the nerve-centers that gives rise to a constant desire for stimulus. A periodic drinker is one in whom there is a gradual and steady increase of irritability in the nerve-centers until a climax is reached. When this period arrives all judgment is set aside; and with the knowledge of previous errors staring him full in the face, even the death of a parent, wife or child, he insanely drains the cup to the bitter dregs again and again. The dipsomaniac is certainly insane. I have seen him kneel in prayer and beg for help against his infirmities, and truly his prayer was earnest and his heart sincere; yet ere he arose from his knees, he drew from his pocket a flask of whiskey and drank deeply of it. If there are superlative degrees of heartache and yearning, they are in the breasts of drinking men, in their burning desire to be free from the thraldom of drink.

As to this form of derangement finding its origin through the visual centers, I desire to call attention to one prominent fact. Among various treatments for dipsomania or drunkenness, are those that involve the use of remedies usually applied by hypodermic injection which causes a dilation of the pupils of the eyes. This dilated condition is usually continued for about the space of one month. Whatever the remedy is, it acts as a mydriatic. It acts by relaxing spasm in the ciliary muscle. It also dims the vision more or less, so that the stimulus to fix both eyes in a parallel plane with each other is lessened; and if there be a short upper, under, inner, or outer muscle, there is but little stimulus to exert its strain; also the vision is fogged, and all this relaxation lessens the labor of the visual centers. My opinion is that so-called cures for dipsomania perform whatever good they effect by temporarily relieving eye-strain. This is also verified by the fact that the same nervous conditions are equally benefited by dropping a mydriatic such as hyoscyamine, hyoscine or atropine into the eye, thus dilating the pupil and relaxing ciliary strain, and at the same time lessening the acuity of vision, so that the stimulus for parallelism is also lessened. During the time the eyes are kept in this dim, relaxed condition, there is a cessation from eye-

strain and the brain irritation dependent on it, and the craving for drink ceases; but after the remedy has ceased to be administered, and the effect has passed from the system, there will usually be a return of the same old strains, inducing a return of the irritation of the nerve-centers, bringing back the old appetite, or at least a condition in which the appetite is readily awakened by sight, taste or smell. There are natures of sufficient strength to continue an abstemious life after the aid of treatment has once been given them; but again there are men who, when the irritation returns, are helpless; their passionate impulses are uncontrollable. Those who are able to resist drink after the brain irritation returns, are often visited by some other form of affliction in its stead, such as disease of the heart, liver, kidneys, sexual organs or lungs. Conversely, we are often able to arrest and delay the progress of consumption by the use of liquor, establishing a form of alcoholism that utilizes those abnormal impulses which were performing the function of building up tubercular tissue; their office is really perverted and the disease thus arrested.

A man may love the taste or the smell of liquor, but without any effort on his part, can use it sparingly. He has really no appetite for it, although the taste and smell are pleasant to him.

Again, a victim who has a vicious appetite may hate the taste, smell and sight, yet for his life, he cannot be prevented from drinking it.

The supposition of the masses in their observation of drinking men, is that such unfortunates resort to the use of alcoholic stimulus for the dissipation, for the pleasure they find in it ; but this view is absolutely incorrect. These men drink for the purpose of diverting the horrors of constantly increasing nervous irritability, which ultimately becomes absolutely unbearable and incompatible with sanity.

Alcohol acts on the nerve-centers by first exalting their action, and then for a time sustaining such an extravagant call upon them that, sooner or later, they become absolutely exhausted and are unable to furnish any more vital force than is just necessary to carry on the unconscious functions of life. Physical strength passes away, the reasoning powers take flight, and unconsciousness ensues, for lack of vital force to carry on these functions. During this period of prostration, all abnormal innervations that were a source of irritation to the brain are suspended. When the nerve-centers begin to recuperate and build up, there is a gradual re-establishment of those abnormal innervations or strains, until they are again so excessive as to be unbearable and a debauch is resorted to once

more as a relief. Now by determining just where these abnormal innervations are, and just what is the cause of them, we may correct these strains and abnormal innervations, and thus relieve the patient without any risk of a return of the uncontrollable appetite and without the risk of some other disease in its stead.

An inflammation in any part of the body is the result of an irritant nerve-supply to the affected part, whereby the sensibility of the part is emphasized to a higher or abnormal degree. The nerves of the smaller blood vessels (vaso-motor-nerves) carry the impulses that cause the derangement; congestion follows and inflammation ensues.

Frequently one inflammation is relieved by producing another, a method that we call counter-irritation; *e.g.*, by a mustard plaster or a vesicant. This establishes its inflammatory or irritant action by sending to the nerve-centers impulses that stimulate them to return that impulse that gives rise to the inflammation that we wish to establish. Although the result is local, the action of the irritant is not. Often has the practitioner applied a counter-irritant when it failed to produce the desired irritation, from the fact that the nerve-centers were in such a low and enfeebled state that they were unable to respond. In mumps, there is an inflammation

of the parotid gland and sometimes a curious thing occurs; the inflammation in the parotid suddenly ceases and at once makes its appearance in the testicle or ovary. This sudden change of the seat of inflammation from one part of the body to the other, not affecting any of the intervening spaces, has been called metastasis, and at first may look like a strange and unaccountable phenomenon; but it is not difficult to understand when we consider that it is that portion of the nerve-centers that presides over the parotid that is disturbed and sending irritant nerve-force to the gland, causing the inflammation, and that there occurs a switching or change of this irritation from this nerve-center to the one supplying the testicle or ovary which is probably conveniently located for the purpose of change. The instant the irritation changes from one nerve-center to the other, the inflammatory action changes its location.

Ovaritis, or inflammation of the ovaries, from whatever source it may have taken its origin, is always due to a disturbance of the nerve-centers that preside over the ovarian functions.

Parturition or child-birth as well as the monthly organic functions of the ovaries, can only be exciting and not primary causes of ovaritis; for if their presiding nerve-centers are vigorous and generous in their supply of nerve-

impulse, these organs always recover from disturbances excited by the above causes. But when they do not recover their normal conditions, the failure results from a lack of equilibrium in the nerve-impulses, and ovaritis is the result. A long continuance of the disturbed conditions that interfere with the organic and assimilative functions of these parts, may ultimately give rise to lesions, the growth of cysts and tumors of various characters, also displacements due to a weakened condition of supporting appendages. The pain and suffering in these parts is central; all feeling is in the nerve-centers, and only apparently located in the parts of the body where we seem to note it. Oftentimes feeling continues to exist apparently in an absent part which has been removed even for many years; for instance a leg. But recently I asked a patient whose leg I amputated twenty-five years ago if his old gout ever troubled him in that part now. His answer was, "Yes, very badly; but I cannot get my foot in hot water as I used to, consequently I have to suffer the pain. Sometimes my toes get crossed, and, not being able to touch them, I am unable to relieve the disagreeable feeling." The nerve-centers that once presided over the foot were in a disturbed condition and caused the unpleasant feelings complained of. Every surgeon is familiar with such com-

plaints, and they teach us conclusively that the feeling of all parts is in the central nervous system.

All medicines or remedies are administered with the expectation or hope that they will correct whatever disturbed functions the disease may consist of. The end sought is to reëstablish normal action in the nerve-centers and thus restore perfect function. Whether the nerve-center is influenced by impulse from without, or by remedy taken into the circulation and carried directly to the part, the action is the same. Just what change takes place in the nerve-centers is somewhat a matter of speculation. We think we have strong reasons for believing it to consist of changes in polarity.

The Homeopathic principle of administering remedies for disease is SIMILIA SIMILIBUS CURANTUR, (or like cures like) and is based on the fact that a certain remedy administered in health causes changes in the function of some particular organ or part. Now, when this part becomes diseased, the conclusion is that the remedy having a predilection to act on these parts will tend to restore them to normal action. Whatever changes are wrought originate in the nerve-centers. How can it be possible to disturb a healthy function without first disturbing the presiding center? Even in the case of injury to a

part, inflammatory action does not ensue until the nerve-centers have received the irritant impulse from the shock or injury; and then they return their characteristic impulses to the injured part, establishing the inflammatory action which, under favorable circumstances, tends to repair the injury.

V.

WE step upon a rough pebble. It hurts. The fact is, that when the nerves of any part of the body come in contact with any substance with sufficient force, that contact produces an impulse or current which traverses the nerves to the brain or central nervous system. This current sent from the outside or periphery to the central nervous system, is called an afferent current. The nerve-center receives this afferent impulse, and responds by generating and sending back to the parts and their surroundings that were originally interfered with, a current or impulse which is called an efferent current; it is also called reflex, being sent back as an image of an object is sent back from a mirror. In medical practice we meet with many serious disturbances arising from what we call reflex causes.

Frequently has it occurred in the experience of the dentist, that in removing a diseased tooth, he has also removed the immediate cause of a serious neuralgia, some form of headache or other nervous disorder; the gynæcologist records many instances where displaced organs have been the cause of reflex diseases in other parts of the body;

the catarrh specialist has found enlarged or hypertrophied turbinated bones to have been the cause of serious reflex diseases; the rectal specialist has recorded many important cures of various diseases in other parts by the relief of some local disease. Pathology records similar reflex diseases to an extensive degree and also relief by a correction of the local disturbance; and the latter has sometimes been regarded as the primary cause of the reflex disease, but this conclusion is in all cases erroneous. For example, let us suppose that ovaritis gives rise to some reflex disease; the fact that the ovaritis is itself the result of some prior cause shows that, as a causative agent, it cannot be primary. So numerous have been such cases and their relief through each separate branch of orificial surgery, that some in each department have become so enthusiastic as to believe that nearly all diseases find their origin through the disturbances found in their particular line of work. Any and all of these views, taken at first sight and considered separately, have apparently much evidence in their favor; but that they are all erroneous is evident from the fact that while these reflex troubles had resulted from the special diseases which were treated, these special diseases themselves must each have had a cause which must still be accounted for. Consequently, any theory

which relies on some diseased condition as the fundamental factor in the origin of disease, must necessarily be wrong, from the fact that the primary disease is itself still unaccounted for.

I wish to be distinctly understood as advocating the importance of correcting all such disturbances locally, as well as removing the cause of their origin. The relief that is afforded by giving them attention, is in many cases truly wonderful. What I wish to point out particularly is the origin of the LOCAL disturbance, for it may be a secondary or tertiary cause of reflex; and if we do not dip still further into the mystery of our trouble, that which was the promoter of the primary local disturbance will turn in some other direction and continue its devastation of the nerve-centers, and the patient, although from time to time relieved of various local difficulties, will be forever a sufferer. This is fairly substantiated by the cases of a large number of nervous women who have submitted to a removal of the ovaries for the relief of nothing more than chronic ovaritis. If the patient recovers from the operation, it is usually recorded as a successful one. True, the local disturbances have been relieved, as rheumatism in the leg would be by amputating the limb; but the central irritation that gave rise to it generally continues and expends its fury in some other direction. At

least, this has been my observation in no less than eighty-four cases. This unsexing of women because of no other disorder than chronic ovaritis, will in a great majority of cases be abandoned; for a more perfect general relief from these troubles will be found in less stringent measures. Clinical experience has repeatedly demonstrated the truth of this statement.

Every local disturbance, to whatever specialty it belongs, has some cause back of it, some abnormal nerve-impulse that gives birth to the unnatural conditions. In rectal disease a constipated habit exists which in itself is simply a lack of impulse to perform the functions of the bowels.

Habitual constipation is always an evidence of nerve-center derangement, a condition in which there is a failure of the dynamic-center to send to the bowels a sufficient amount of motive-force to perform the function of absorption, secretion and muscular action, necessary to carry on the daily offices of health in these parts. The derangement is in the nerve-centers, and any relief that is obtained from this condition must always be obtained by regulating the action of the nerve-centers that govern the bowels. A pill or any cathartic is taken into the mouth, and passes on through the stomach into the intestines. Its presence there acts as an irritant which sends an

afferent impulse to the nerve-centers; from thence is reflected an efferent impulse that carries to the bowels a working motive-force that sets their various functions in motion and an action ensues. Often has the medical practitioner met with a case of constipation existing in connection with some serious disease that has resisted the action of the strongest purgatives; locally, these remedies have reached the bowels; but the low, disturbed state of the nerve-centers has been such that they have not been awakened to respond to the irritant impulse, which was sent. Sometimes constipation will be the only prominent local defect in general nervous derangement. In many cases, we find constipation coexistent with general nervous debility and various forms of local derangement; but it may always be considered a nerve-center derangement and the opposite of chronic diarrhœa, which is due to an excess of motive-force to the bowels from irritant causes. When the motive-forces or impulses proceed from healthy nerve-centers and pass along the nerves that carry them to the entire digestive apparatus, there is perfect secretion, perfect digestion, perfect absorption and perfect daily movement constituting health in these parts. It is the lack of such innervation in some part or parts which gives rise to the various disturbances.

The secretion or manufacture of the various constituent parts of the digestive fluids, such as pepsin, diastase, lactic acid, hydrochloric acid, bile, in short all organic products, is the direct outcome of the peculiar nature of the nerve-impulses to the various organs, and is largely characterized by the peculiar form and structure of the parts that do the work. These are the little engines, and any alteration in their nerve-impulses causes a derangement in the products of their work. It is easy to conceive of such an abnormal alteration in the motive-impulses as to produce uric acid and other abnormal products which are found in various diseases. The presence of uric acid is said to be the cause of certain diseases, whereas the truth is, that which is the cause of the uric acid is the primary case of these diseases; AN ABNORMAL IMPULSE BRINGS FORTH AN ABNORMAL PRODUCT.

The results of nerve transplantation are positive evidence that the function is not characterized by the peculiarity of the nerve, for we can transplant efferent nerve fibre to the place where afferent has been without altering the character or nature of the function.

But, is there really more than one kind of nerve-force? Although we speak of impulses as motive and sensory, or those that perform functions of motion and feeling, besides these we also have

nerve-impulses that are performing the functions of assimilation, and again those that are performing more complex organic functions. Instead of these varied functions being due to different kinds of nerve-force, is it not possible that the anatomical or histological structure of the various parts in connection with an adequate supply of nerve-force, is that which dominates the nature of the function? If so, only quantity need be considered in all changes.

We do not inherit disease, but we inherit those conditions which give rise to disease, such as imperfect anatomical structure of parts which, for the performance of their functions, require excessive nerve-force; also imperfectly developed nerve-centers, which are predisposed to localized irritation. Thus by heredity we may be liable to a particular train of diseases, such as consumption, alcoholism, diabetes, Bright's disease, various forms of catarrh, with a tendency to that weak condition which especially renders one a victim to malarious and contagious diseases.

"Tubercular consumption is not a local but a constitutional disease, and calls for general treatment. Tubercle bacilli do not and cannot cause consumption in a perfectly healthy individual, They induce disease only in persons with lowered vitality, who thus become susceptible to their influence."

The most prominent pathological change in motor-ataxy or tabes dorsalis is located in the spinal cord. Tabes dorsalis is not, as has been carelessly affirmed, the cause, but it is one of the results of disease; and the changes in the spinal column are due to causes anterior to them, affecting the nutrition of these parts, and the sclerosis follows. I speak particularly of this, because we are frequently prone to select some predominant pathological condition of a disease and attribute the disease to that as its cause, whereas it is only one of its results, concomitant conditions, or prominent lesions. But these pathological conditions may act as causes for the establishment of still further reflex diseases, producing localized disturbances that act as secondary reflexes, the influence going further and further until we have reflex causes quite a number of removes from the primary.

The fact that great relief has followed the correction of local disturbances of the rectum, female organs, nasal passages and local irritation of other parts of the body, all of which are abnormal innervations, ought to lead us to expect even greater relief from the correction of an abnormal innervation through the visual centers, for they are much more acute than any of those nerve-centers that preside over and govern the action of other parts of the body.

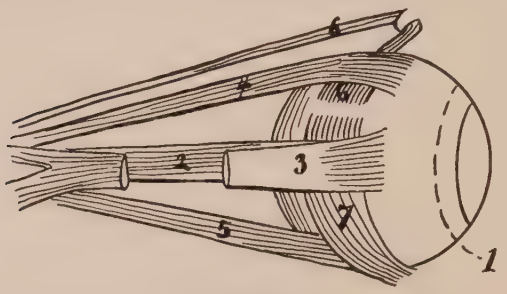
In determining the cause of a disease, it is very important to discriminate between exciting and predisposing causes, for we commit an error in resting our judgment on some exciting cause as being the sole element of the disturbance. This can always be laid down as a wrong conclusion where the same or a similar exciting cause fails to bring about universally similar results. If the same exciting causes are brought to bear on two persons and one is affected by them and the other not, there is somewhere a difference in the two individuals. There is a predisposition in one which causes him to yield to the exciting causes. In the other the predisposition does not exist. Whatever may be the disease arising from an exciting cause, this reasoning will hold good.

Exciting causes may be a draught of air, wet feet, exposure to cold, the monthly physiological processes in women, pregnancy, over-exhaustion, poisonous gases, malarial and infectious germs, injuries, excitement, grief, poisonous drugs of various kinds, opium, cocaine, bromides, mercury, lead, alcohol, tobacco, and quite an extended list might be made. The action of any of these is emphasized by predisposing causes; for a large class of individuals in a general sense have immunity from the effect of some of the above causes especially the after effects of narcotics and poisons. Any investigation of a disease is remiss if

it stops at exciting causes. Acting in conjunction with predisposing causes there may be several exciting causes that give rise to a disease and its continuance. A general neurasthenic condition will be a predisposing cause; and tobacco, alcohol, malaria, over-work, change of life and exposure to cold may all be exciting causes in bringing on a disease. Because we have found one prominent cause for a disease, we should not relax our search for others.

VI.

EACH eye has seven muscles which perform all the movements necessary in the functions of vision. Four of them are called recti or straight muscles, as follows: the superior rectus muscle



EYE MUSCLES.

1. Ciliary muscle (within the ball).
2. Internal rectus.
3. External rectus.
4. Superior rectus.
5. Inferior rectus.
6. Superior oblique.
7. Inferior oblique.

turns the eye upward, the inferior downward, the external outward, the internal inward or toward the nose; two are called the superior oblique and the inferior oblique, the offices of which are to rotate the eye on its antero-posterior axis. The seventh is the ciliary muscle which is within the eye-ball and surrounds the crystalline lens. Some of the above mentioned muscles are assisted in the performance of their functions by other muscles. This is explained at length farther on.

When we think of the complex arrangement of these muscles in the two eyes, we must know that for the easiest possible vision, it is necessary that they should be absolutely perfect as to length and their attachments; also that the crystalline lens should be anatomically correct. Here we have in the two eyes, sixteen anatomical parts that must be without fault. This naturally leads us to infer that the perfect eye is an exception, and a wide experience has taught us that irregularities in in some of these parts are very common. It would be marvelous if one pair of eyes in a hundred were absolutely balanced without the intervention of nerve-impulse to overcome some slight defect. These muscles are often so imperfect in length and irregular in their attachments, as to cause the eyes to deviate many degrees from the normal position. When the axes of vision deviate so far that it is impossible for the nerve-impulses to pull them back into line, we have a condition commonly known as strabismus or squint. The deviation may be outward, inward, upward, downward, or a combination of two of these directions. When the angle of deviation is so great that it cannot be corrected by the nerve-impulses that operate these muscles, the effort to produce single vision becomes more or less suspended and the laborious work of the nerve-centers is abandoned. Usually one of the eyes suppresses its vision; for, as long

as double vision of the same object exists, there will always be an effort to fuse the two images into one for the sake of avoiding confusion and increasing the sense of sight.

Defects in various parts of the eye, including the muscles as to their length, may exist to a very considerable extent and yet the function of vision be perfectly performed. Some of the muscles may be so short that they would cause the optic axes of the two eyes to deviate many degrees if it were not that the opposite muscles pull them into a normal position, through the intervention of nerve-impulse. Nerve-impulse is also the primary factor in causing the ciliary muscle to contract around the crystalline lens, increasing its refractive power when it is deficient. Just how fixed and permanent, through a long lapse of time, these nerve-impulses may become, acting as masks to anatomical defects, is the object of our chief inquiry.

Eyes that perfectly perform the function of vision may have hidden defects to an alarming extent and in proportion far greater than the novice would expect. Some little evidence in this direction can be had from the following: I do not believe that full suspension of abnormal innervation takes place in blind eyes, but suspension does to a certain extent. Through a period of many years, I have been observing the eyes

of the blind with the especial purpose of noting their relative positions, and I cannot recall one individual case in which the optic axes had not deviated in some direction.

A similar condition of affairs exists in the eyes of a new born babe. One or more muscles may be defective as to length. Whoever has watched the eyes of these little ones has noted how aimlessly they wander about during the first few days, until finally the stimulus for fusion causes them to fix their vision; and then for the first time, the two eyes begin to look in the same direction and so continue.

"The eyes of new born infants are almost invariably hypermetropic." (Berry.) This being true, it is the long continued effort of the ciliary muscle that brings about the emmetropia of later life, which is so firmly fixed, that even mydriatics sometimes fail to discover latent hyperopia.

In fourteen autopsies, not one exception was found to the unequal development of long muscles. In eleven of these cases, the superior rectus in the right or left eye was thin, tendonous and undeveloped, giving evidence of having been on the stretch, while that of the other eye was invariably a well developed muscle, and the converse condition of the inferior muscle was always found. In two of these eleven, the external muscles were undeveloped, while the internal

showed a high state of muscular development. In one of the remaining three, a habitual drunkard and suicide, the internal muscles were thin and tendonous, the externals being highly developed; in the other two, the externals were simply thin, attenuated tendons, the internals being highly developed. The superior and inferior muscles in the last three cases were so poorly developed that they gave no evidence of any relative difference. A more general inquiry and a larger experience than I have had the fortune to acquire in examining the ocular muscles and the positions of the eyes of the dead, will bring out much valuable evidence in this field which as yet is comparatively new.

Look into the dim windows of the brain twenty-four hours after death, and a deviation of the eyes from a perfect position will always be found. This evidence is also against the theory of muscular weakness or paresis as a general cause for the deviation of the eyes, for in death no innervation exists, and no relative strength or weakness. They naturally fall into the positions that the relative lengths permit them to assume. Even then the full defects do not become manifest, for the long stretched muscle will yet be too long; but all this information comes too late for the life which is ended. Too late for aught but an apology for perhaps many a cen-

sured weakness, which, after all, was no more than the manifestation of some physical infirmity for which the victim was morally blameless. Under infirmities thus insidiously induced, but as resistless as the lightning, a Dr. Jekyll becomes a Mr. Hyde. Let us judge justly of the infirmities of man or judge them not at all. THE TENDENCY OF A PERFECT BRAIN IS TO A PERFECT BODY AND A PERFECT LIFE. The perfect development of a brain or any part may be prevented by the existence of some irritant cause. People with disagreeable dispositions and habits are not always responsible, as their peculiarities are possibly the result of abnormal nerve-impulses over which they have no control; and such people should excite our kindliest feelings rather than our condemnation.

Several years ago I was called from a great distance to see a patient suffering from what was at times a severe craving for alcoholic stimulus. During this period excessive amounts of liquor were drunk, the debauch continuing about one month. His dissipation was as deep as possible. After this followed the period of sobering. Then for three or four months he would again lead a perfectly abstemious life. He was notably kind and generous to the poor; lent great aid to moral institutions; was a kind, good father and husband, and seriously devoted to the church. It was at

the conclusion of one of his sprees that I reached his home too late to see him alive. On the following day, the thought came to me that if eye-strain had had any connection with his infirmity, it perhaps might manifest itself after death; so, in the company of his old partner and friend, and two undertakers, I carefully raised his eyelids. The left was fixed in a normal position, the right was turned upward fully twenty-two degrees. Such evidence ought to be a sufficient explanation and vindication of many acts that may have incurred censure during life.

The average person of middle age whose eyes are apparently perfect, may be seated behind an 8 deg. prism, base down, when at twenty feet a light will appear as two lights, one directly over the other or vertical. According to the prevailing idea, this indicates that the eyes are balanced as far as the lateral or external and internal rectus muscles are concerned. Now, if this balance depends upon the anatomical length of the muscles, the following test would indicate it; but it does not. I place on the patient in trial frames, say 6 deg. of prism, base out; I direct the patient to look around the room for a few minutes; I now renew my test with the 8 deg. prism, base down, while the 6 deg. prism is still on the patient. One of the two lights still appears to be

directly over the other. We are now certain that we have 6 deg. of prism unaccounted for by the test. Sometimes we are able to put as high as twenty or even more degrees of prism over the person's eyes, base in or out, as just described, and after they have been used for an hour, more or less, the two dots or lights in the test will still appear to be vertical. If it had been only the length of the muscles with which we were dealing, and the lateral muscles balanced without prisms, when we put on 6 deg. of prism, base in or base out, we ought to have found the difference in length by the irregularity in the position of the lights; but in such cases the difference does not appear in this way, and such experiments clearly demonstrate how uncertain all diffusion tests are. Long trained, and more or less fixed abnormal nerve-impulses will hide defects from these tests that would otherwise cause the eyes to deviate many degrees.

Now, if this tendency to single vision asserts itself with such alacrity and certainty under an artificially created irregularity, how much more would the constant effort of years working and pulling against a muscle that is too short, have a tendency to hide the defect from all diffusion tests?

The various disturbances taking their origin in the visual nerve-centers from eye-strain, have

been doing their devastating work, have been generating from the very time of birth, from the very hour the two eyes first began to train together, those conditions that are conducive to disease. From that moment, nerve-force waste and brain irritation with its correlated consequences began. It is true, in certain cases, that some of the most distressing symptoms of disease are often relieved immediately on a correction of the abnormal innervation; but it stands to reason that the greater portion of disturbed conditions, which have been so many years in assuming definite form, will require patience and time for perfect relief. A new established order of things must be set up. The various nerve-impulses that perform their characteristic functions must all be changed. The centers that generate this force and the avenues they travel, must all be differentiated. A new correlation has to be established, and sufficiently long established to maintain a permanency of the new and desired condition of affairs. If in six months, a year or more, the impulses from the nerve-centers have become so altered as to turn aside some disease where death was imminent, we can well say that the patient and the physician have been well rewarded and that the time was short, although the patience of both has been severely taxed.

The immediate relief of pain that sometimes

follows the application of glasses or operations, must not be considered infallible indications of a speedy cure. Such a relief is simply an indication that we are proceeding in the right direction; and, although a pain may be stopped, or a prominent and alarming symptom subjugated, before perfect health is restored there are other fully as important changes to take place which will require a space of months and perhaps years. Often serious diseases or conditions exist that are accompanied by no prominent symptoms of pain; nevertheless they are as emphatically threatening life. Where disturbed brain centers have been for years furnishing imperfect motive-force to perform the various functions throughout the body, the functions become more or less enfeebled. Their structural assimilation has been imperfect. In such a case, when pain is relieved by a change which we have wrought in the nerve-centers, we must expect to wait some time for the permanent establishment of those motive-impulses that normally control assimilation and organic functions. It takes time to rebuild that which has been many years in breaking down. We are apt to become enthusiastic when suddenly relieved of some pain or alarming symptom; but the process of reconstruction that follows the new supply of vital force is a slow one; we are not conscious of it from day to day; we

can realize it only after a much longer lapse of time. If these changes are carefully noted through periods of several months, more or less, we can become calmly conscious that years will be slowly added to life. The good that follows repression may possibly keep on building up and restoring for a space of years. The sustaining power of repression is well established in such cases as Nos. 5, 16 and 17, pages 95, 113 and 114.

In the slow development of latent eye defects, we learn how obstinate and unyielding long established abnormal nerve-impulses are, how they repeatedly persist in their endeavor to return during development after we have held them more or less repressed for several months. We have a correspondingly new state of affairs established, a changed condition of innervation which is young, and more or less uncertain. We may be somewhat prepared to expect at times a temporary return of the old impulses, especially when the nerve-centers have been subjected to exhaustion, or when their equilibrium is disturbed by alcoholic stimulus, or by an exhausting debauch in any direction. Under such conditions the new ocular correlation will become temporarily confused, which plainly indicates a need of rest, but after a time this confused state ceases to present itself.

VII.

A SHORT muscle on examination by diffusion tests may present itself in four different ways.

First. It may be wholly manifest, in which case any and all tests will give like results.

Second. It may be partly manifest and partly latent to the test.

Third. *It may be absolutely latent with no manifest defects.*

Fourth. *Spasm may cause the eye to manifest the reverse of the anatomical condition, in which case the eye will deviate in a direction opposite to that of the short muscle. This is the dangerous condition that I have elsewhere pointed out.*

The first four of the following cases are given as illustrations of the four forms of eye-strain, respectively.

Case. 1. Presented by the president of the Johnston Optical Co., of Detroit. Left eye turned upward 20 deg. above the right. While reading, writing or looking intently at any near point, the inferior muscle of the left eye drew it down to a level with the other; but when not so employed or while looking off into the distance

or holding ordinary conversation, the nerve-centers would invariably relax their effort and the eye would turn upward fully 20 deg. into a position of perfect rest; so, the greater part of the time there was no strain in this case, no constant waste of nerve-force, no unremitting source of brain irritation; consequently this person suffered little or no disturbance of the nerve-centers. He was calm, quiet, and generally free from ailment. No correction was made as the person felt no necessity for it.

The following cases were treated by repression. They are selected for the purpose of setting forth some of the most prominent features of the treatment in which tenotomy and muscle advancement are often necessary. Sometimes the desired results are arrived at without an operation, the repression being effected entirely by glasses.

When prominent symptoms of a disease have been subdued, we are naturally led to believe that our work in repression is more or less complete; but it has so often proved incomplete on later examinations, that it is never safe to draw such conclusions. This will be clearly illustrated in the following case from Dr. Stanley of Brantford, Ont. In any particular case treated by repression alone, the only satisfaction we can have is to know that we have proceeded suffi-

ciently far to establish a more perfect and happier condition of previously disturbed functions.

Case 2. Partly manifest; D. A., age forty; Dr. Stanley of Brantford, Ont., says this case has been under his observation for upwards of four years; that from the first it was a very active and marked case of diabetes mellitus, and, toward the latter end of this period, neither diet nor medical remedies seemed to make any impression in lessening the gravity or reducing the prominent symptoms. I saw the case first on October 10, 1889. Specific gravity, 1.052; thirst unquenchable; voided twenty pints of water in twenty-four hours; sleep broken and restless; obliged to get up four or five times during the night; anxiety and general nervous symptoms very depressing; skin dry and scaly.

No hyperopia was found by dropping a two grain solution of atropine into the eyes twice a day for one week; then increasing to four grains to the ounce, it was used for three days, and on examining the eyes again I still found no indication of hypermetropia. Vision without the glasses was twenty-twentieths or normal. I prescribed a + 1 D glass for outdoor use, which gave twenty-fiftieths of vision at twenty feet. For house, reading, writing and all close purposes, I prescribed a + 4 D, which was 1 D more than an absolute suspension of accommodation at thirteen

inches. This rendered the patient artificially myopic. At the expiration of three months, through the 1 D glasses at twenty feet, vision was twenty-twentieths. On removing the glasses, vision was also normal, but on returning them to the eyes again, the vision through the glasses was now reduced to twenty-thirtieths, but in half an hour it was again twenty-twentieths or normal. I now increased the power of both pairs of glasses .75 of a dioptre, which again gave twenty-fiftieths of vision at a distance, and the glasses for near use about the same amount of artificial myopia that the first pair of reading glasses gave. At the expiration of six months more, vision under the 1.75 D, at twenty feet, was normal. On removing these glasses, it now required some five minutes for normal vision to take place, indicating that the reduction of ciliary innervation was becoming somewhat fixed. The glasses were continued, as well as the above modus operandi, for a period of one year, since which time the patient has been wearing + 2.75 for all general purposes. With these glasses vision is twenty-twentieths at all distances, but for the purpose of resting the accommodation, a + 5 D is frequently resorted to for long and continued close work. This ciliary repression was carried on during the treatment of the long muscles, which was as follows :

Created horizontal diplopia; found the superior and inferior rectus muscles balanced. Vertical diplopia disclosed 3 deg. of convergence. Sufficient prism to make up for the convergence produced no change in symptoms. On the supposition that the manifestation was correct, which it proved to be, and that an unknown quantity of latent defect might be in the same direction, I gradually increased the prism, base out, until, within an hour, under 30 deg. of prism, the intolerable thirst had entirely disappeared; the feet, which had been constantly cold, became warm; from a sallow paleness the complexion became flushed and ruddy; the pulse was reduced from 110 to 76. The prisms were now removed. On the 11th, the tests were repeated with similar results as on the previous day. On October 12 the patient could diverge for 12 deg. of prism, base in. These were kept on the patient in this position for nearly two hours. All distressing symptoms were very much aggravated until the patient exhibited great uneasiness and alarm. The hands and feet were cold, the complexion very pale, while the pulse mounted to 130. The prisms were removed, and an unusually uncomfortable night followed. On the 13th, 30 deg. of prism were again accommodated for, and worn for two hours. A general relief followed. At this time, the 30 deg. proving somewhat tire-

some to the eyes, I reduced the prism to 20 deg., which the patient continued to wear for one week. The thirst did not return, the nights were somewhat more comfortable, the quantity of water reduced to ten pints, while the circulation and warmth in the extremities were considerably enhanced. On now adding 20 deg. more of prism temporarily, a perspiration appeared on the forehead and other parts of the body, the first the patient could remember having had for nearly four years.

Partial tenotomy was now performed on each internal rectus muscle, leaving but a few of the outer fibres. I now had 4 deg. of manifest divergence, but the symptoms were not so materially relieved as they had been under the prisms; he could still accommodate for 40 deg., base out. Twenty degrees were constantly worn, base out, for two weeks following this, at which time I made a complete division of both internal tendons, not detaching them from the capsule. Under diplopia I now had 16 deg. of manifest exophoria. Vision was single to within a distance of about fourteen inches, but diplopia existed for all distances nearer. The repression in the external muscles was now considerable; the thirst was entirely gone and the daily quantity of water reduced to seven pints; gravity 1.035; feet warm; skin moist; cheerfulness came; sleep more con-

tinuous and refreshing. The gravity was reduced slowly and was at times variable. On the first of May following, it was 1.020. On the 4th of July, 1890, gravity was 1.016. All tests now failed to find the slightest trace of sugar. Repeated examinations at various times through a space of four years have resulted in finding no sugar. Perfect health has prevailed. Patient paid me a visit in September, 1894, having been through a year of tedious work, with some very harassing reverses. Was feeling somewhat depressed and nervous; specific gravity 1.020; no trace of sugar; no other diabetic symptoms.

By diplopia, the lateral eye muscles were perfectly balanced as well as the vertical. By differential test, namely prism base down before one eye, then the other, the patient was able to accommodate for several degrees more of prism on one eye than on the other. I at once began repression in this direction, and in one week the patient was wearing 14 deg. of prism base down before the right, or divided between the two eyes, with a perfectly satisfactory relief from nervousness and depression. The color of the skin was very much improved.

To be certain that these changes were due to the above repression with the 14 deg. of prism, I at once reversed it. In the course of two hours the patient was able to fuse for 10 deg. in the

opposite direction. The complexion turned pale, the pulse mounted to 96, the hands and feet grew cold, and a very nervous and excited condition ensued; in ten hours the test of the urine showed sugar; gravity 1.038. The patient was very much alarmed. I immediately reversed the prisms. Nevertheless, a restless night was spent. Gravity was 1.030 in the morning, but by evening it had fallen to 1.020. On the following day it was 1.018 with a perfect alleviation of the disturbed conditions.

I now made a complete division of the superior rectus of the right eye, not detaching it from the capsule. This eye was now thrown below its fellow 6 deg., vision was easy and single with the head slightly elevated. On looking upward there was double vision. At the end of three weeks no inconvenience from double vision remained and the patient's condition was in every way satisfactory. A letter was received from the patient seven months after the last operation, all conditions of health being reported perfect.

This and many other cases that can be shown prove that, although the prominent symptoms of disease may be entirely relieved, as this diabetes was for a space of over four years, considerable abnormal innervation may still exist. The fact is, our first operations relieved the nerve-centers suffi-

ciently to place the diabetes under subjection; but during all this time a considerable abnormal innervation was existing. The exceeding prominence of the defect in the lateral muscles was sufficient to hide completely that existing in the vertical direction. It might have been found had it been looked for after the first operations, but the improvement in the general conditions naturally led us to suppose that we had done all that was necessary.

I look upon the above as in no way a stubborn case. The abnormal innervations yielded very readily to the repression. The abnormal innervation giving rise to tonic spasm is sometimes so stubborn, that it fails to yield at times, even for months. Then suddenly it will relax and advance rapidly into high degrees bringing marked relief. This will be found illustrated clearly in case No. 19.

Case 3. Absolutely latent; M. S. M. twenty-nine years old; married ten years; highly intellectual; graduated from a collegiate course at the age of eighteen with the highest honors; had always been a bright, vivacious girl, but was of a somewhat excitable nature. Had always been inclined to a constipated habit; at the age of twenty-two began to suffer with occasional pains and local disturbances in the region of the ovaries, and this condition continued to increase until it

became an almost constant source of suffering. At the age of twenty-seven other complications set in, neuralgic pains in the upper portion of the spine, also in the dorsal region. She now had a constant desire for water, ices, or cold drinks; was voiding large quantities of water, being obliged to get up two or three times in the night for that purpose. Her case was diagnosed as diabetes depending on chronic ovaritis, and in council a removal of the ovaries was advised. Preparations were made for the operation, but, through dread, it was abandoned. At about the time she visited me, she had again decided to undergo the operation. I found the specific gravity of her water 1.044, eighteen pints in twenty-four hours, perfectly clear and free from color; thirst quite marked; the smell of acetone was very perceptible in the breath; skin dry and scaly. She was excessively nervous and irritable.

I created diplopia with prisms which at twenty feet gave no indication of any irregularity in any of the eye muscles; vision was normal at both far and near points. Could converge for 40 deg. of prism, and diverge the optic axes for only 6 deg. At the near point, vertical diplopia gave no evidence of any irregularity in the lateral muscles. While under the converging prisms, base out, her thirst and nervousness were aggravated, so I reversed the prisms to base in; causing the eyes to

diverge 6 deg. A perceptible relief followed. Founding my judgment on this test, I now began repression of innervation to the internal muscles, by having her wear 6 deg. of prism, base in, for distance, and when reading 20 deg., base in, in connection with a +3D glass for suspending the effort of accommodation. The thirst was subdued almost at once, and the nervous symptoms markedly relieved. On the following day she was able to wear 8 deg. of prism, base in, without creating much double vision. At the end of one month, by gradual repression, she was able to tolerate 20 deg. of prism, base in, without creating diplopia. During this repression, the pains in neck, back and ovaries were greatly diminished, and the constipation was entirely relieved from this time on.

On removing the glasses, I now had a highly manifest case of exophoria. By the finger test, approaching it close between the eyes, I found the right eye less inclined to converge. I made a complete division of the tendon of the external muscle of the right eye on the immediate line of its attachment to the sclerotic, after which there still remained a manifest exophoria of 3 deg. by diffusion test. I continued repression in the same direction, in ten days again arriving at 14 deg. of prism. I now made a complete division of the tendon of the external muscle in the left eye. In

neither operation was the tendon detached from the capsule. After the last operation, all symptoms were materially relieved; the thirst was entirely gone; the amount of water voided was now five pints with a specific gravity ranging from 1.026 to 1.030; the pains in the ovaries, back and neck were gone. The only disagreeable feature to the patient now was that my last operation had turned the eyes inward 10 deg., and for a time all objects were seen double. I now placed on her eyes sufficient prism, base out, to bring about single vision again. I decreased this prism 1 deg. at a time, varying through a period of two weeks, at which time she was able to see objects properly, directly in front of her, but on turning the eyes either to the right or left, they would again appear double.

I continued the repression process by putting on 1 deg. of prism, base in, then two, letting her wear each change until fusion had taken place. This I continued until she was able to accommodate for 8 deg., base in, which was in about three months from the last operation. On now removing the prisms, easy single vision was possible directly in front and to both sides sufficiently far to be perfectly practicable.

Six months after the last operation, every trace of sugar had disappeared from the secretions, the quantity was normal, and not a trace of ovaritis

or spinal irritation was left. The general health was admirable.

It is true this patient was obliged to suffer considerable inconvenience and annoyance during the treatment. The double vision was unpleasant and perhaps alarming to the patient and friends, but the result far more than counter-balanced all these trivial annoyances. A dangerous capital operation was avoided, and health and happiness restored.

One year after this patient left my care, she gave birth to a healthy eight pound boy. Three years from this time, although her health had remained perfect, she returned for an examination. Artificial diplopia, both vertical and horizontal, disclosed a perfect balance in all the muscles. At this examination, finding no functional derangements, I made no further effort by repression to discover if abnormal innervation still existed.

Case 4. Reverse manifestion; woman, thirty-six years old; married twelve years; no children; when a girl suffered from headaches, with pain in the back of the neck and between the shoulders; since the age of twenty-two had gradually increasing sensitiveness and pain in both ovaries, the left being the worst; habitual constipation; at the age of thirty kidneys began secreting larger amounts of water than normal; at this period a gradually increasing thirst set in; no sugar was

ever discovered in the secretions. An operation for the removal of the ovaries was seriously advised. The patient was determined to die rather than submit to it.

Six months before she visited me, an aggravating cough set in. At the time of her first visit, on the twenty-second of November, 1892, the amount of water passed was twenty-four pints in twenty-four hours; specific gravity 1.002; thirst insatiable; no sugar. By diffusion test the superior and inferior muscles were apparently balanced, the external and internal muscles turned the eyes inward 4 deg. I corrected this by placing 4 deg. of prism, base out, on the patient. In an hour the prism test again showed 2 deg. more of convergence. I corrected this; in half an hour, under 6 deg. of prism, base out, there were 2 deg. more of manifest convergence. Instead of balancing this with prisms, I overcorrected by 24 deg. Within an hour all distressing symptoms were very much aggravated, especially the pain and thirst. I concluded from this that the manifest convergence was due to spasm and that the prism was increasing it. I now removed the glasses. After twenty minutes the patient was able to accommodate for 4 deg. of prism, base in; in half an hour 2 deg. more were tolerated, increasing the divergence of the eyes. The thirst and pain were somewhat relieved. I now put on the patient 10 deg. of

prism, base in, and sent her home for the night. This gave double vision for any distance beyond ten feet.

November twenty-third. At noon the patient was able to see objects single under the 10 deg. prisms. I now tested with prisms at the near point, 12 inches, at which distance 12 deg. more of divergence were manifested, which made in all 22 deg. at the near point. I now suspended accommodation with a +3 D glass, and overcorrected the entire amount of divergence manifested at the near point by putting on 28 deg. of prism, directing the patient to continue reading as long as possible. In a quarter of an hour the mouth had become moist, the thirst had entirely disappeared, and the pain in the ovaries was gone. The distance prisms were increased to 12 deg. and the repression kept up at both far and near points for three days. The improved conditions continued. This decided the patient to undergo whatever temporary inconveniences were necessary to this treatment. On the twenty-sixth of November I made a complete division of the tendon of the external muscle, not separating it from the capsule. Three days later a division of the opposite tendon was made. The result was 16 deg. of manifest convergence. Double vision existed at all points beyond twenty inches. Vision was now made single by 8 deg. of prism, base out. This

was reduced almost daily. At the expiration of ten days, vision without glasses was single, directly in front, but double on looking either to the right or left. Repression was continued with prisms, base in, increasing them one degree at a time, through a period of three months, when 14 deg. of prism were worn, base in, with single vision for all distances. The amount of water was now reduced to five and one-fourth pints in twenty-four hours. The most rapid reduction was during the first few days of treatment. The only ovarian difficulty now left was, that, when the patient was lying on her back, she could not straighten her left limb without producing a slight pain in the left ovary.

Sufficient divergence had taken place, so that I now advanced or shortened the internal muscle of the right eye sufficiently to give 12 deg. of convergence again. Repression was continued. At the end of three months, vision was single without glasses. This convergence would have corrected itself in time without the use of prisms but not so quickly.

I have seen the patient occasionally through the space of nearly two years, and not a trace of the old difficulty has ever returned in that time.

Ignorant criticism of this class of cases, where diplopia or double vision has been created for the purpose of reversing or repressing an

abnormal nerve-impulse, has proved very injurious to a large class of sufferers, in many instances costing life; a criticism that is conscientious, no doubt, as many see no deeper into the necessities of the eyes than that their muscles should bear a perfect balance physically; but such critics do not seem to know that physical balance is often sustained by an alarming degree of unbalance or inequality of nerve currents, that is destroying the equilibrium of the brain centers, and fast robbing them of vital forces that should be expended in other directions. As it is the abnormal impulse alone that is sapping life of its forces, that is disturbing the brain, we must look sufficiently deep to discover this disturbing force, and, when necessary, temporarily sacrifice the apparent muscular balance, which, under proper care, rights itself in from a few days to a few months. Discontinuance of the treatment in obedience to this criticism has often resulted fatally to the patient in a very few days. *The great danger lies in the eyes remaining in that abnormally balanced condition that is threatening life.* The following cases, Nos. 5, 6 and 7, are illustrative of this statement:

Case 5. June, 1890, Mr. McL., of Windsor, Ont., aged forty-six, was voiding eighteen pints of water in twenty-four hours; specific gravity 1.044; thirst intense, with symptoms of portal congestion;

an appearance of excessive jaundice; very nervous; pulse 115; chronic diarrhœa. After determining that the external muscles were short, and that considerable strain existed in the ciliary muscles, I began repression by relaxing one of the external muscles, and putting on heavy fogs at once (+ 5 D). In three days time the eighteen pints of water were reduced to six; the thirst was entirely relieved; the jaundice color of the complexion had cleared; much relief was experienced as to the portal congestion; and the diarrhœa was relieved as well as the indigestion. The patient was able to walk but a few rods when I first saw him. By the end of one week he was able to walk two miles without experiencing any inconvenience. On the tenth day the specific gravity was 1.032 and the patient had so gained in strength that he was able to walk four miles without fatigue. This was the last visit he made; for, in his weak mental state, he was led to believe that the changes he had experienced could not be the result of anything that had been done to the eyes. By advice, that which I had done was undone; the glasses were removed, and superseded by a prescription of opium and atropine. The condition of the patient grew rapidly worse, and on the twenty-eighth day after I last saw him he died.

Case 6. August 15, 1890; Mr. R., of De-

troit; age thirty-five; clerk in clothing store; had suffered for past two years from excessive melancholia; he was nervous, irritable and his nights restless; was habitually constipated; six months before visiting me, he began to notice considerable difficulty in walking, especially in the dark, with a gradual and partial loss of feeling in the lower limbs; symptoms of motor-ataxy developed rapidly. On his first visit he was unable to turn around quickly, while walking, without great danger of falling; was unable to stand with his eyes closed; complexion pale, feet and hands cold. I began repression with prisms and plus spherical glasses. During the first day, considerable warmth was restored to the extremities and a ruddier color to the skin. At the end of three weeks he had so improved that he was able to stand, without falling, while his eyes were closed. There was some improvement in the walk; he was now able to turn around with much less clumsiness. The improvement in this case was very considerable for the space of two months, at which time Mr. R. felt able to return to his duties in the clothing store, which had been abandoned for three months previous to the treatment.

The repression glasses were somewhat disagreeable, and during my absence in the East, Mr. R. was induced to abandon them and try a

treatment that consisted of suspension. From this time his condition grew worse, and at the end of three months he put a period to his existence by shooting himself.

Case No. 7. F. G. age thirty-five; bright, intelligent and for several years actively engaged in business; suffered occasionally from vertigo and extreme nervousness. A few weeks previous to coming to me, on returning to his home one evening he was seized with dizziness, temporary partial loss of vision, and was prostrated for several weeks, being confined to bed. It was now first discovered that he was suffering from diabetes. His devoted brother, who had been a patient under this treatment, went to visit him, and by slow stages and resting, brought him to me. I found his specific gravity 1.050; fourteen pints of water in twenty-four hours; thirst intense; pulse 105; unable to walk but a few rods, and that with great exhaustion. Repression rapidly subdued his thirst; reduced his gravity in two months to 1.024; his pulse to 75. In three months he had gained fourteen pounds in weight and enjoyed a walk of two or three miles. He returned to his home two thousand miles away. Ciliary repression was continued by a high grade of fogging. During a space of four months very bright and encouraging letters concerning his health were received. Riding, driving and fish-

ing excursions were indulged in with great pleasure. He wrote a letter telling that he had been able to dance eight round dances in a night. This, of course, I at once advised against. A few days after this he had the misfortune to have all his glasses broken, and neglected for three weeks to have them replaced, at the end of which time he was suddenly taken ill again. Hurried correspondence by his sister followed, asking for glasses. Then came a telegram that he was much worse, and the following day another announcing his death. This and the two previous cases are three only of many similar ones that I have known. The uplifting and sustaining power of repression is as clearly demonstrated in these, as in that class of cases that have resulted favorably.

I do not assume that cases Nos. 5, 6 and 7, which resulted fatally, would have been cured had they continued treatment; but as far as the treatment was carried, the evidence was most markedly in its favor.

Where defects exist in several of the muscles, the defect is sometimes so prominent in one as to hide completely the defects in the others, which only manifest themselves to us after a correction of the first. The reasons for this will be discussed at more length after clinics

Case 8. J. A. age twenty-four; farmer; had

suffered from epileptic seizures since sixteen years of age, which gradually increased in frequency until they were of daily occurrence; the mental faculties were very much impaired; the power of speech was affected to the extent that it was very difficult to understand the patient; the right upper and lower extremities were partially paralyzed, so that his walk consisted of a dragging, halty gait, while the right hand and arm were used but little, and clumsily; constipated habit, and complexion pale.

Vertical and horizontal diplopia disclosed no muscle defect; convergence was 45 deg.; divergence 2 deg. After a careful examination lasting three days, I began repression with prism, base down, before the left eye, which, when forced to 8 deg., led to an improvement in the color of the skin and the action of the heart, diminishing its activity from 95 to 75 beats per minute, with a feeling of warmth and tingling to the right hand and foot. Several tests were made by removing the prism and reversing its position, in which case the above symptoms were increased. From these indications, I now crowded the prism to 14 deg., base down, before the left eye. Twice I was obliged to reduce the prism 2 or 3 deg. to prevent diplopia, from the spasms that would ensue. The epileptic seizures were now reduced to one-third in number, also much in severity. I now made a

complete division of the superior rectus muscle of the left eye. The cut eye assumed a normal position. The opposite eye turned upward 18 deg. It required 12 deg. of prism to bring about fusion. I began reducing this, degree by degree, but the opposite eye was very slow and obstinate in getting back into line. At the end of six weeks, not having accomplished this, but still retaining single vision with prisms, I again examined the lateral muscles with the same result as at first, 2 deg. of divergence and 45 deg. of convergence with this difference; vertical diplopia now indicated 5 deg. of convergence. I now added prism, base out, to correct this, and exceeded the correction by putting on the patient 24 deg. of prism, which were worn for three hours in my office, during which time the face became pale, the hand and foot cold, followed by a fit of considerable severity which lasted five minutes. This decided me that the present manifest convergence was due to spasm; so, on the following day, I began repression at the near point, suspending accommodation with a fog, or +4D glass, and 20 deg. of prism, base in, diverging the eyes. In two hours 4 deg. of prism, base in, could be tolerated with single distant vision. I added a +1D glass reducing the distant vision to twenty-fiftieths. At the end of ten days the patient was wearing 12 deg. of prism, base in; the vertical displace-

ment that resulted from the operation had corrected itself; the eye had come down into line while I was diverging the eyes and repressing the REVERSE MANIFEST defect in the lateral muscles. From this time on all conditions improved rapidly. The power of speech returned; no fits have occurred since, with the exception of occasional petit-mal. At the end of one month, 20 deg., base in, were tolerated with single vision. I now advanced the internal rectus of the right eye. When last heard from, the patient had passed one year of perfect health, during which time the ciliary had been kept under a repression of a +2D glass for general purposes, with reading glasses +3D stronger.

Had this patient abandoned treatment after the first operation, which I had to use persuasion to prevent his doing, he undoubtedly would have suffered the inconvenience of double vision for a considerable length of time, as the result of a want of correction in the second defect.

Case 9. Paralysis. Mr. E., aged sixty-five, passed an active business life up to sixty years of age, when he first began to experience restless nights with little sleep; a growing irritability with occasional attacks of dizziness; several months of each year were spent at health resorts and watering places with some little improvement at first; but, on returning to business, the dis-

turbed conditions would return after two or three weeks. For one year a dull pain was constant about the base of the brain. On January 15, 1872, while sitting at breakfast, he was stricken with apoplexy and was unconscious for twenty-four hours. The next day on returning to conciousness, it was discovered that he had partially lost the power of speech and the use of the right upper and lower extremities. After three weeks he was able to limp about with the help of an assistant. The vertigo was excessive; there was a constant dread of some impending evil; the memory and reasoning faculties were much impaired. With varying conditions of health, the paralysis still remaining, he visited me in 1892 when his condition was rapidly growing worse. In this weakened and depressed condition, as is usually the case, the irregularities in the ocular apparatus were very manifest. A short under muscle in the right eye and inner muscle in the left were found, with one dioptre of manifest hyperopia. Repression in all three muscles was begun at once. At the end of the second day there was a marked change for the better; the internal rectus now was detached. Immediately after this operation, the patient noted a perceptible improvement in the return of a natural feeling to the paralyzed side; no inconvenience resulted; his speech was very much improved. The re-

pression was continued, and in two weeks from this, he was wearing with perfect ease and single vision, 14 deg. of prism, base down, before the right eye. The impediment in the speech was now entirely gone, also the spells of dizziness; the feeling of fright passed away, and in one month from the first, his visits were made without the necessity of having an attendant with him; and were continued for the space of two months. From this time on, his circulation was good; his bowels, which had been previously constipated, were now regular; he acknowledged that he felt better than he had felt for ten years. During the space of over one year he has attended, without the slightest inconvenience, to whatever business he has had to do; he eats and sleeps well, and says that he enjoys every moment of his life.

Case 10. Consumption. In 1873, in company with my father and Dr. Goodrich, of Bellevue, Ohio, I visited Mrs. S. on a farm in Huron county; she had suffered for a year and a half with consumption; in the six months previous to my seeing her, she had had two hemorrhages; the afternoon fever and night sweats had been very persistent for seven months. Little or nothing was hoped for in her case; her principal treatment had been hypophosphites and cod liver oil, alternated each week with large doses of rich

cream. Incidentally, during this visit, Mrs. S. asked if her left eye, which was very much turned inward, could be straightened. I told her I thought so, and a few days later it was operated upon. An over-correction of several degrees resulted from the operation; of course this was not sought for, but it established a repressive strain. I paid two visits after the operation, after which I did not see the patient, as she moved to Hazelton, Pa. Two years passed, when one day the husband of Mrs. S. walked into my office. He talked with me some five minutes without referring to his wife, who I felt confident was long since dead. He said, "You don't ask me about Mrs. S." I said, "I did not wish to distress you. I suppose she is no longer with you?" He said "That's just where you are mistaken; she is perfectly well and hearty and weighs nearly two hundred pounds." He reported that a few months after I last saw her, her cough ceased and her health began rapidly to improve. This case was not operated on with the expectation of influencing the diseased condition of the lungs, but later experience has caused it to be recalled to my memory as a result possibly due to the radical change in the nerve-centers resulting from the repression established by the operation.

Case 11. Woman; age twenty-two; consumption; constipated habit; complexion pale; pulse

85 in the morning, in the afternoon and evening 120, with a hectic fever which had existed about ten months; bright red spots about the size of a penny on both cheeks; nights restless, and for the past six weeks night sweats were profuse; lower lobe of left lung congested and dull on percussion; cough quite severe; no hemorrhage. Examined this case in the morning; pulse 85. Repression was made with prisms by turning left eye up 12 deg. In thirty minutes the pulse was reduced to 64. To this prism was added ciliary repression reducing distant vision to twenty-fiftieths. The next morning better conditions were reported for the previous afternoon and night; pulse was now 76. Repression was now made at the near point by forcing the eyes outward 24 deg., and fogging with a +5 D spherical. Patient looked at pictures in a book for half an hour; had great difficulty to avoid going to sleep while sitting in the chair; pulse reduced to 64; a healthy, red glow covered the entire face, ears and neck; the hands and feet grew warm. Patient now wore away + 3 D spherical, 14 deg. of prism, base down, before the left eye, combined with 18 deg., base in. Repression was being made in three directions. From this time on, there was no more hectic fever, flush, or night sweats; at the end of two weeks from the first visit, the cough had entirely ceased; the only symptom that

remained was dullness on percussion of the lower lobe of the left lung. At the end of one month eight pounds had been gained. At this period a very serious interference with the treatment occurred. The patient's sister was taken ill. She watched by her bedside constantly for eight days, when the sister died. This, of course, told heavily against any further advancement in the case, but none of the old symptoms returned. On the day of the funeral, from over-exhaustion and grief, the nerve-centers were so disturbed, that I was obliged to reduce my prism 6 deg. in various directions to still maintain fusion. After she had had a few days' rest I increased the prism to its former standard. Two weeks after burying her sister, she was wearing 18 deg., base in. I now advanced the right internal muscle, leaving 10 deg. of convergence, which in ten days had entirely disappeared. I now advanced the inferior rectus of the left eye, bringing it 6 deg. below its mate. A slight vertical diplopia existed after this operation, but in three weeks it had entirely disappeared. At the expiration of six months the patient had gained twelve pounds and her health in every way was perfect.

Case 12. Male; age twenty-five; acute consumption; was constipated; anæmic; had cold hands and feet; weight one hundred and nine pounds; pulse 90 in the morning, in the evening

115; night sweats had been continuous for two months previous to the first visit; a severe cough had existed for five months, and the expectoration was a thick mucus; the sputa was not examined microscopically; there had been no hemorrhages; the left lung was dull on percussion and its breathing space limited, especially in the lower lobe. The diagnosis of consumption in this case was based on the evidence of the above symptoms without the microscopic examination of the sputa, the occurrence of a hemorrhage, or any apparent disintegration, but all of the other symptoms were well marked.

The treatment consisted of repression of the ciliary with +5 D glasses, which were worn most of the time; 2 D were permitted for outdoor purposes for limited periods. These gave but twenty one-hundredths of vision; repression also of both external and left inferior rectus muscles. The complexion at once changed from a pale to a pink color; the hands and feet were warmer. At the end of two weeks the patient was wearing 16 deg. of prism, base down, before the left eye, which was repressing the innervation to the inferior rectus muscle. A division of the superior muscle of this eye was made at the end of two weeks. The cough ceased at once; constipation was now relieved, and the heart's action reduced to 70. Repression in the ciliary and both exter-

nals was continued with glasses for two weeks longer. I now made a complete division of the right internal and advanced the left external, by my operation of a single stitch and a ligature plate, thus bringing about 10 deg. of divergence by diffusion test. One month after the last operation there still remained 3 deg. of divergence, while the vertical muscles were balanced.

This case was heard from seven months after the last operation. The general health was much improved; none of the old symptoms remained; eighteen pounds in weight had been gained.

Case 13 was the mother of the above patient, who accompanied him during his treatment; her age was forty-four; had suffered from chronic bronchitis for five years; was of slight build; anæmic; had suffered much from headaches and spinal irritation; had cold hands and feet; pulse was normal. Ciliary repression was made with glasses that gave twenty-fiftieths of vision. Repression of the right inferior rectus was continued for one month, when she was wearing 22 deg. of prism, base down, before the right eye. Complete division of the tendon of the superior rectus was now made. The cough ceased the first day; the hands and feet were warmer; the general circulation was much improved; the headaches and spinal irritation were entirely relieved. This case was also heard from seven months after leaving,

when the health was reported good, with a gain of eleven pounds in weight.

Case 14. Male; age forty-one; symptoms of consumption fourteen months; pale, very nervous and restless; occasional pains in left lung; lower and middle lobe dull; occasional night sweats; hectic fever in the evening accompanied by an excessive sensitiveness of the entire right side of the face, also of the cheek inside the mouth; no inflammatory action existed in these parts; cold water had to be drunk with great care to prevent its coming in contact with the right side of the mouth, in which case it gave rise to distressing pain; right side of face could not be touched with a feather or even a hair without giving rise to great distress and alarm. This patient had been advised to have the facial nerves cut out to relieve the painful sensitiveness. The case yielded slowly to repression; at the end of six weeks the left eye had turned upward 15 deg.; at this time +3 D glasses gave twenty-thirtieths of vision. I did not fog the vision to the same extent in this case, because I needed a higher acuity to assist in the repression in a vertical direction. There was some general improvement in all the conditions of the patient up to this time. I now advanced the inferior rectus of the left eye, using my ligature plate, which drew it 6 deg. below its fellow by diffusion test,

but double vision did not result. The sensitiveness in the face and inside of the cheek entirely disappeared within three days. Repression in the ciliary was now increased by fogging the patient to twenty-sixtieths for distant vision, adding +3 D more for reading purposes, so as to suspend entirely the action of the ciliary for the time being; the constipation was entirely relieved from this time; the cough ceased, and in five months this patient had gained thirty pounds in weight; pulse 70; appetite and complexion good. Perfectly good health continued for a little over one year, since which time I have not heard from the patient.

Consumption. I have made preliminary examinations and repression tests in one hundred and twelve cases of consumption, and in all with the exception of nine, some of which might have yielded by longer persistence in the tests, I was able to bring about marked changes in the prominent symptoms, generally consisting of a reduction of the high action of the heart, change in the color of the skin, increase in the warmth of the hands and feet, where the extremities had been cold. None of these cases were treated further than a few preliminary tests. In such cases there is a great lack of patience to undergo the repression; but this is quite natural to nervous persons, inasmuch as they generally lack

confidence in the possibility to affect lung diseases through the visual centers. Consumption is most markedly a nervous disease. Its premonitory stage is marked by nervous conditions which, emphasized in character, accompany it through all its stages. F. J. McGillicuddy, A.M., M.D., of New York, says, "Tubercular consumption is not a local but a constitutional disease, and calls for general treatment. Tubercular bacilli do not and cannot cause consumption in a perfectly healthy individual. They only induce disease in persons with lowered vitality, who thus become susceptible to their influences." I am thoroughly convinced that a large percentage of consumption takes its origin from irritation arising through the visual centers, and that many cases, especially in their earlier stages, are amenable to treatment through the same medium.

Case 15. Mr. F.; age sixty; delicate habit; constipated; very nervous; at the age of twenty was attacked with paralysis agitans, or shaking palsy, which lasted through a space of forty years. At the time I saw the patient his trouble was complicated with chronic bronchitis, sciatica and spasmodic stricture of the neck of the bladder. Repression of the ciliary and inferior muscle of the right eye with glasses brought some alleviation of the shaking. A complete division of the superior rectus was made, after which,

while my hand was still resting on the forehead, I noticed the shaking suddenly cease. The patient turned pale, was nauseated. He said, "I feel strange; I think my shaking is over." The spasm at the neck of the bladder also passed away at once, doing away with the necessity of using a catheter which had been required for the past three years in voiding the urine. I heard from this case occasionally for two years. The constipation, sciatica and chronic bronchitis were very much reduced, and there had not been any return of the shaking palsy or of the irritation of the bladder.

Case 16. Gen. C. of the United States Volunteers; age sixty; dyspeptic; much depressed; in weak and rapidly failing condition; progressive atrophy of the optic nerves had gradually destroyed the vision, until barely enough sight was left to enable him to get about the streets; he could recognize friends only by the sound of the voice; could not read; would write from habit but could not see what he wrote; vision was so imperfect in this case that I could utilize but little fusion power in repression. It was three months before I arrived at a conclusion, at which time I made a complete division of the right internal rectus muscle. There was an immediate improvement in the general feelings, and in three months from this time the patient had gained twenty-

eight pounds in weight, and was able to read ordinary newspaper print, which I advised him to do sparingly. One year later distant vision was normal; general health and appearance were excellent.

The following case that resulted fatally is evidence by no means adverse to the value of this treatment. The patient was in a very critical state at the time treatment was commenced, and the result verifies the sustaining or supporting power of repression during the time it was continued.

Case 17. H. H., age fifty; diabetes mellitus; gravity 1.048; quantity sixteen pints in twenty-four hours; intense thirst; very weak; unable to walk but a few rods; repression with prisms and by fogging vision to the possibility of reading ordinary type not farther than twelve inches, removed the thirst, and in three weeks reduced the specific gravity to 1.030 and the quantity to seven pints in twenty-four hours; heart's action was reduced from 100 to 75. These conditions were maintained with but little change for the space of three months, with the exception that the gravity occasionally fell to nearly normal, 1.022, and again went up to 1.030. The uncertainty of further results and the tediousness of the fogging process, were the cause of the patient's abandoning treatment at this point, removing the glasses

and resorting to water cure treatment. A week after the glasses were discarded the bad symptoms had all returned, and in three weeks the patient was dead.

Case 18. H. H., girl; age ten; nervous, mischievous, playful child; after receiving slight chastisement from her teacher had a severe attack of St. Vitus's dance, which lasted for three months. This was followed by complete paralysis of the right side, and of the power of speech; the mental faculties became a perfect blank; the child's attention could not be attracted in any way, she would not even look up on being repeatedly called by her name; parents were obliged to feed her by putting food into her mouth. The left eye was partially blind; this was determined by covering the right, when the child would make an effort to uncover it; but she paid no attention when the left was covered. Under the influence of chloroform administered at three different times, a manifest defect in the superior and internal muscles of the left eye was very apparent. Under the existing conditions, I could only approximate the defects. A complete division of the internal rectus was made on this diagnosis. Plus 3D glasses for repressing any possible ciliary strain were tolerated by the child, but any stronger than these were rejected.

In two months she was able to walk, consider-

able impediment yet being noticeable in her speech, but her mental faculties were in every way very much improved. In examinations of the eyes, she was now able to answer questions. Repression was commenced by forcing the left eye upward with prism. More improvement in the use of the paralyzed extremities was noticed.

A division of the superior rectus of this eye was made. In four weeks from this time, the child was able to walk with a somewhat halting gait, and use the right hand. In eight months from the time I first saw the patient, not a trace of the difficulty was left. The child was now witty, intelligent, active, and desired to return to school. I advised her not to do so. After a lapse of two years I saw this little patient again, and in perfect health which had continued since the treatment. Two years later, making in in all four, I received a letter from her father stating that her general conditions of health were excellent.

Case 19. Male; age thirty-five; was a bright and promising youth, quick to learn and more than ordinarily ambitious. He was eccentric, his disposition and habit being so changed at times that they might belong to another person. At the age of twenty-five, he was actively engaged in a successful business, and from this time these changes of disposition grew gradually more

marked. His choice of friends and associates was usually fastidious; but every three or four months a period of two or three weeks would intervene, in which all his leisure hours would be spent in neighborhoods strange to his former associations, and among people of the coarsest type. These periodical changes of disposition and association were as marked and regular as the sprees of a periodic drunkard. Through a general increasing nervous debility he, at the age of thirty-two, was thoroughly incapacitated for work, and the business passed into the hands of another member of the family. He was now unable to carry on a coherent correspondence. His memory was very much impaired; he was unable to fasten his mind upon either book or newspaper; and, if he tried, a moment afterwards forgot whatever he may have read. At times he was morose and surly, and would be dangerous to cross. Again, being very sympathetic, he would break down in a child-like way, and from some imaginary cause would be moved to tears. Again his ambitious side would return and he would speculate in ridiculously impossible schemes. Through incompatibility his wife now deserted him; consequently his disturbed mental symptoms were rapidly and greatly emphasized, and at the age of thirty-three he was placed in an asylum. From this time his scheming and eccentric ambitions

ceased. For the next two years despondency was the marked feature of his condition, occasionally alternated by spells of pitiful repining and regret.

It was in this condition that he was brought to me by his mother. The only notable local symptoms were a pale complexion and a heart's action of 96. It required fully an hour of careful handling on my part before I gained his confidence and secured his attention sufficiently to proceed with an examination; but he gradually grew very much interested, and was no longer disposed to interfere with my tests. Refraction in both eyes at the far point was above normal, twenty-fifteenths. It was perfect at the near point. By diffusion test, far point, prism base down before the left eye, the upper dot or light was 2 deg. to the left. With prism base in the left light was the lower, manifesting a left hyperphoria of ½ deg. in conjunction with a manifest esophoria of 2 deg. at the far and near points. Two degrees, base down, before either eye created diplopia. Could fuse 1 deg. before either eye, but with my vertical chart, using a 2 deg. prism, base down, before the left, there were two dots 2 deg. apart, while 2 deg., base down, before the right separated the dots or lights 1 ½ deg. from each other. I now placed before his right eye 1 deg. of prism, base down. After a few minutes vision

seemed sharper. This was shortly increased to 2 deg., and within half an hour to 3 deg. Pulse was not materially changed. Even with repeated efforts the next half hour I failed to increase the prism. The countenance was somewhat flushed and a violent headache followed, which was something from which he had never suffered before. The prisms were removed and tests continued the following day. The next day I commenced with 1 deg., base down, before the left, the reverse of the previous day's treatment. In an hour he had accepted 5 degs. of prism in this direction, the complexion was paler and the heart's action had mounted to 124, with an increase of nervous symptoms. I now changed the position of the prisms to the same that it had been during the first day's test, base down before the right eye. In another half hour he was able to fuse for 4 deg. of prism. The pulse was reduced to 86, and the skin became somewhat flushed. Headache again returned and the test was abandoned for the day.

As to symptoms, base down before the right diminished somewhat the excitability of the heart and improved the color of the skin, while at the same time it brought on severe headache. With prism in the opposite direction the heart's excitability was much increased, the complexion paler, and the nervousness visibly aggravated.

On the following day I chose that position which improved the heart's action and the color of the skin. Four degrees, base down, before the right was all he could fuse under. He was allowed to wear this home the remainder of the day. His night's rest was slightly improved. During the next test, he was able to fuse for 6 deg. of prism. The glasses were comfortable during the day, and the vision remained single until just before bedtime, when headache again set in. On awaking in the morning, he was unable to fuse for his 6 deg. of prism, and after having spent a restless night he returned to my office without the glasses. His eyes now manifested the reverse of every previous condition; the right eye appeared to be the lower of the two. This I suspected to be due to spasm, owing to a bad night's rest. I proceeded, degree by degree, to coax the eyes to fuse under prism, base down, before the right. I was unable to succeed with more than 3 deg., which I left on the patient.

On awaking in the morning he was able to fuse for the 3 deg., and came to my office wearing the glasses. He now succeeded in fusing for 7 deg. early in the morning. He wore the prisms all day with comfort and some little improvement in feelings, his heart's action being reduced to 80.

On the following morning his eyes would not fuse for 7 deg., but by my orders he kept the

glasses on until he arrived at the office. I did not remove them, but suspended the ciliary accommodation with a +3 D spherical glass. Fusion at the near point took place at once. After reading a short time and having the sphericals removed, he was able to fuse for all distances. These glasses were continued during the day. The night's rest was much improved. When he put on the glasses after awaking in the morning vision was double, but after half an hour fusion had taken place. Complexion was decidedly better and the heart's action the same, 80. At present, prism could not be increased above 7 deg. I now suspended accommodation with +3 D spherical glasses, and at the near point was able to increase my prism 3 deg. more. After he had looked at pictures for half an hour, the pulse was reduced to 76, and the face was quite flushed, with some little nausea. The following day the same was repeated without the nausea. I now increased the glasses to +5 D. Buzzing in the ears shortly followed this, dizziness, nausea and profuse perspiration; pulse reduced to 70. I now suspected that the ciliary had suddenly relaxed its tonic innervation and on examination, found his vision normal with a +1.50 spherical glass in connection with the 7 deg. of prism, base down, before the right eye. He now manifested 3 deg. of exophoria, instead of 2 deg. of esophoria which

had showed on the first examination. At the near point the exophoria was 18 deg., whereas the first examination gave 2 deg. in the opposite direction. The correlation that had existed under abnormal conditions was now practically broken down, and a partial manifestation of the actual state of the muscles presented itself. Plus 2 D spherical glasses and 7 deg. prisms were worn until bed time, which was an hour earlier than usual, and he slept ten continuous hours, the longest period of rest that he could remember for many years. On the following morning his eyes accepted the 7 deg. of prism but rejected the spherical glasses ; everything seeming exceedingly foggy and dim through them. The ciliary spasm had returned. The long night's rest had recuperated the nerve-centers, and they refused to yield to the same conditions that had controlled them on the previous day. I now increased to 10 deg. of prism, base down, before the right, a +5 D spherical, and 18 deg. of prism, base in, because of the fact that, in the relaxed condition of the previous day, he had manifested this amount of exophoria at the near point. Under this combination, even at the near point, some considerable difficulty was experienced in inducing the eyes to fuse. After they had fused, reading was continued for half an hour, when the nausea and profuse perspiration again set in. The patient was induced to tolerate

the glasses and these discomforts for half an hour longer, when the pulse had fallen to 62. The patient now returned home with three pairs of glasses, 7 deg., base down, before the right eye, 18 deg., base in, with +2 D spherical glasses. Nine hours of continuous sleep followed. In the morning his eyes fused under the 7 deg., base down, but again rejected both other pairs. It would be needless to detail this case further. The process of discovering the abnormal innervations that had maintained a perfect correlation in the action of the two eyes, had now revealed the defects, while the mental condition of the patient showed marked signs of improvement. Changes in the manifestation of the eye defects continued from day to day to reveal and again hide themselves until, at the end of one month, the patient was wearing before the right eye 20 deg. of prism, base down, and 20 deg. of prism, base in. I now made a complete detachment of the superior tendon of the right eye, dropping the eye 6 deg. below its mate. At this time I had the patient wearing 20 deg. of prism, base in, with +2.50 spherical glasses, which gave normal vision. The complexion from now remained good, and the pulse was never found above 72. Two weeks after the first operation the left external tendon was completely detached, producing 8 deg. of esophoria by diffusion test, but lights fused without prism. Repres-

sion with prisms, base in, was continued for three weeks, when 16 deg. could again be tolerated without double vision. I now completely detached the external tendon of the right eye. Under diffusion test, there were now 16 deg. of convergence and an inability to maintain single vision farther than fifteen inches. Plus 2.50 D sphericals were continued with 6 deg. of prism, base out, to bring about fusion for distance. This was reduced slowly from day to day and, in three months from the last operation, no double vision existed.

The patient's mental condition was now entirely relieved. He seemed happy, would smile, laugh at anything funny, and seemed fond of telling witty anecdotes. The only abnormal condition that now existed was that, on looking to the extreme right or left, double vision would occur. I deemed it advisable to keep the distance vision at twenty-fortieths, thus continuing a slight ciliary repression.

I have occasionally seen this patient during the space of two years. His mental condition has continued very satisfactory; none of the eccentricities of his earlier life have recurred; his whole character seems changed; he is of a quiet, happy disposition, and attends to whatever business he has to do without worry.

One year after the first operation a perfect

balance existed in all ocular muscles under diffusion tests. He fused for 4 deg. of prism, base down, before either eye, 6 deg., base in, and 45 deg., base out. A new and perfect correlation had been established.

Case 20. Mrs. H., Joliet, Ill. This patient was brought to my office by Dr. Orin W. Moon, of Lockport, Ill. She says she has suffered for the past ten years from female weakness consisting of chronic inflammation and neuralgia of the ovaries; severe headache preceding and through the menstrual period; has always been of a delicate habit; catarrh of the throat, eustachian tube and internal ear has been increasing for the past ten years with a gradual loss of hearing; for the past two years the right ear has been totally deaf while the left could distinguish loud conversation only at a close distance. Has taken various remedies almost continuously for the past ten years. The catarrhal difficulty and deafness were treated locally, the treatment including dilatation with the Pulitzer bag and catheter.

Vertical muscles apparently balanced; 5 deg. of convergence at the far point; esophoria at the near point, thirteen inches; at the start I fortunately suspected this to be a case of reverse manifestation. I suspended ciliary strain with a +5D glass, and with 30 deg. of prism, base in, found that the patient could fuse at the near

point. I directed her to read in the above combination, and in ten minutes she could hear a faint whisper in the left ear and ordinary conversation in the right. By repression I developed exophoria of 20 deg. at the far point, and on the fourth day made a complete division of the tendon of the external rectus of the left eye. All of the previous disturbances were at once relieved; within one month the catarrh had disappeared; all sensitiveness and neuralgia in the ovaries were now gone, and for the first time in her life the monthly sickness came and passed without the slightest headache or local disturbance. In every way the general health has been much improved and the patient says she feels perfectly well.

I do not present this case as an ordinary one, but because it is one of the quickest and most remarkable cures in the history of my practice.

The following tabulated list of clinics has been selected from a large number of cases for the express purpose of showing what class of cases have yielded and may possibly yield to repression treatment. Failures in about the proportion noted in the preceding detailed clinics could be shown. A report of adverse results would be of no value as it is the object of this work to show what can be accomplished through the visual centers. The failures are due to several causes,

especially neglect to follow treatment, and to the fact that some cases are beyond or outside of its influence

DISEASE.	MARRIED OR SINGLE.	DURATION.	SEX.	AGE	PERIOD OF TREATMENT.	RESULT.
Ovaritis with general female weakness	M.	5 yrs.	F.	38	3 mos.	Cured.
Prostatitis with inflammation of the neck of the bladder	M.	12 "	M.	58	1 mo.	Cured.
Insanity	M.	5 "	M.	50	8 mos.	Cured.
Uric Acid Diathesis, rheumatism and general nervous debility	M.	8 "	F.	53	2 mos.	Cured.
Chronic Rheumatism	S.	10 "	M.	48	4 mos.	Very much relieved.
Asthma	S.	20 "	F.	51	1 mo.	Cured.
Insanity	M.	5 "	F.	32	7 mos.	Cured.
Diabetes Mellitus	S.	4 "	M.	40	1 yr.	Cured.
Paralysis hemiplegia	M.	12 "	M.	55	1 yr.	Cured.
Motor Ataxy	S.	3 "	M.	38	5 mos.	Much improved.
Prostatitis and irritation of the bladder	S.	12 "	M.	50	5 mos.	Cured.
Rheumatism	M.	8 "	F.	55	6 mos.	Cured.
Consumption	S.	1 "	F.	22	8 mos.	Cured.
Consumption with nervous debility	S.	15 "	M.	25	8 mos.	Cured.
Ovaritis	M.	8 "	F.	26	3 mos.	Cured; was previously barren; had a healthy babe 1 yr. after treatment
Hay Fever	M.	10 "	M.	34	3 mos.	Cured.
Heart disease functional.	S.	5 "	F.	16	3 mos.	Cured.
Glaucoma	M.	5 "	M.	53	4 mos.	Cured; one eye was blind at beginning of treatment.
Nystagmus	S.	20 "	M.	28	1 mo.	Cured.
Heart disease functional	S.	3 "	F.	22	6 wks.	Cured.
Prostatitis	M.	20 "	M.	65	1 mo.	Cured.
Rheumatism	M.	15 "	F.	58	1 yr.	Cured.
Diabetes insipidus	M.	3 "	F.	37	8 mos.	Cured; was previously barren: gave birth to a healthy babe 18 months after treatment.
Ataxy	S.	1 "	M.	32	3 mos.	Much improved.
Bright's disease	S.	2 "	F.	40	4 mos.	Cured.
Ovaritis	M.	6 "	F.	30	2 mos.	Cured, previously barren; 18 mos. after treatment gave birth to a healthy babe.

DISEASE.	MARRIED OR SINGLE.	DURATION.	SEX.	AGE	PERIOD OF TREATMENT.	RESULT.
Anæmia and general nervous debility	M.	10 yrs.	F.	32	4 mos.	Cured; previously barren; had babe 10 mos. aftertreatment.
Insane and paralyzed	S.	6 mo.	F.	11	9 mos.	Cured.
Prostatitis and irritation of the bladder	M.	10 yrs.	M.	68	1 mo.	Cured.
Cirrhosis of the liver	M.	12 "	M.	45	4 mos.	Cured, has remained perfectly well for two years.
Melancholia and sterility	M.	8 "	F.	37	1 yr.	Cured; gave birth to babe 10 months after treatment.
Constipation and nervous debility	S.	12 "	M.	27	6 mos.	Cured.
Insanity	M.	8 "	F.	51	9 mos.	Cured.
Chorea	S.	2 "	F.	12	3 wks.	Cured.
Diabetes mellitus	M.	1 "	M.	49	9 mos.	Cured.
Shaking Palsy	M.	10 "	M.	60	1 mo.	Cured.
Rheumatism, chronic	M.	9 "	F.	63	7 mos.	Cured.
Melancholia, constant dread	S.	6 "	M.	41	6 mos.	Cured.
Diabetes mellitus	M.	1 "	M.	49	9 mos.	Cured.
Shaking Palsy	M.	10 "	M.	60	1 mo.	Cured.
Rheumatism, chronic	M.	9 "	F.	63	7 mos.	Cured.
Melancholia, constant dread	S.	6 "	M.	41	6 mos.	Cured.
Asthma	S.	12 "	F.	28	2 mos.	Cured.
Prostatitis	M.	9 "	M.	50	6 mos.	Cured.
Ovaritis, sterility	M.	9 "	F.	26	5 mos.	Cured; had healthy babe 9 mos. after treatment.
Chronic ulcerative catarrh	M.	6 "	F.	43	8 mos.	Cured; had been pronounced and treated as syphilitic catarrh.
Hay fever	M.	12 "	F.	36	1 mo.	Cured.
Motor Ataxy	S.	5 "	M.	45	4 mos.	Much improved in every way.
Constipation and dyspepsia	M.	50 "	F.	72	2 mos.	Cured.
Sciatica and uric acid diathesis	M.	15 "	M.	65	6 mos.	Cured.
Hay fever	S.	6 "	M.	51	3 mos.	Cured.
Consumption	M.	18 mo.	M.	45	7 mos.	Cured.
Diabetes insipidus	M.	2 "	M.	43	1 mo.	Cured.
Shaking Palsy	S.	5 "	M.	65	3 mos.	Cured.

VIII.

WHEN the optic axes deviate or have a tendency so to do, the fault has commonly been attributed to muscular weakness or paresis. If the left eye deviated above its mate, this theory assumed that the inferior muscle of that eye was insufficient in strength to hold it down. If it deviated inward, the outer muscle was said to be too weak; if outward, the inner muscle was too weak. This reasoning naturally assumes that to maintain a balance, there is a constant contention in the various eye muscles, and whenever a muscle becomes weaker than its fellow, there will be a deviation in a direction opposite to the weak one. That this can hardly be true is evident from the fact that the internal rectus is known to have generally fully five or six times the strength of its opposite, the external rectus; and if it were a relative difference in strength of the muscles that caused the eyes to deviate, all eyes having muscles of such comparative strength would be constantly turned in toward each other. The fact is, it is not a question as to the relative strength of the muscles. Normal eyes should, under absolute relaxation of all

the muscles, be in a perfectly parallel plane for an infinite distance; although some muscle might be weak, an eye would present perfect balance with absolute relaxation of the muscle opposite the weak one. WHEN THE OPTIC AXES ARE NOT PARALLEL, THE CONDITION IS DUE TO ONE OF TWO CAUSES—EITHER AN ANATOMICALLY SHORT MUSCLE, OR ONE CONTRACTED BY SPASM. This rule does not hold in paralysis, which can not be determined by a relative position of the optic axes alone, but by individual movements of one eye. Neither are the tendencies to relative deviation generally due to paresis, a term sometimes used in lieu of muscular asthenopia.

The almost universal deviation of the eyes of the dead, the blind, the new born babe; of those who have been rendered unconscious by the use of anæsthetics, alcohol or narcotic poisons; and of those who are in a state of suspended animation from other causes, such as fainting, apoplexy, or coma, is due to a suspension of innervation more or less complete, during which the eyes fall into those positions in which the anatomical length of the muscles would naturally hold them. Deviations under the above conditions are certainly not due to paresis or muscular weakness. True, we do have weak muscles, but they are generally on the side of the eye opposite to that in which the theory of muscular as-

thenopia would have them. For instance; when the deviation of an eye is due to a short external muscle, tending to draw the eye outward, it is the external muscle which is really insufficient, asthenopic, or undeveloped, for never has it had normal action. It has always been drawn upon and stretched by the opposite muscle, in the effort of the latter to pull the eyes into line. In such cases, gymnastic exercise of the ocular muscle in which there is a manifest deviation will sometimes restore the physical balance, but it does so by making the defect latent again. It does its work by once more increasing the already excessive innervation to a hiding standard. For the muscle that we increase in strength by gymnastic exercise, is the over-developed one. This exercise simply stretches the short muscle more, and increases the abnormal innervation in the strong one; hence the results of these gymnastics are the opposite of what we should seek to obtain. Such exercise will often restore a balance of the optic axes, but it does so at the expense of the nerve-centers.

In that class of cases where there is a manifest deviation of the optic axes, and where such deviation is due to a spasm, which usually turns the eye in a direction opposite the short muscle, gymnastic exercise will bring some relief, for it represses in a small measure the abnormal inner-

vation, as it brings the eyes back into line. This relief might possibly be increased by crossing the line of balance and forcing the eyes in the opposite direction to a considerable extent by repression.

There is always a physical comfort in seeing easily, but the disturbances arising from eye-strains are not always local; they do not always affect the vision.

Whenever the shortness of a muscle begins to manifest itself, we may infer that the nerve-centers have wearied of holding the eyes in place and begin to suspend their labor. There is an effort of the nerve-centers to rest from an over-taxed condition, and we should always aid them as much as possible in this effort. This is done by placing prisms before the eye in the direction opposite to that prescribed in gymnastic exercise, increasing our prism in this direction as long as fusion will take place. We establish a repressive strain in the opposite direction; that is, a strain in which there is an effort to suspend nerve-impulse which has become excessive and more or less fixed in the muscle opposite the short one.

By exercising this repressive strain for a few weeks or even months, we cannot expect to suspend absolutely and entirely an abnormal nerve-impulse that has required many years to attain its

present intensity. We should reasonably expect long periods of time to be necessary to repress these brain leaks that have been established since birth.

A tendency to deviation of a given number of degrees, say 6, will give rise to varying amounts of strain in different individuals; for, although by reason of the shortness the eyes tend to deviate 6 deg. in each case, the innervation that brings the eye back into line will vary in accordance with the size, strength and elasticity of the short muscle. A thin, weak muscle causing the axes of the eyes to deviate 6 deg., would require a certain amount of motive-force to correct the defect, whereas, a broad, tendonous, inelastic muscle that turned the eye 6 deg. would require much more motive-force to bring it into place. So, THE NUMBER OF DEGREES OF DEVIATION IN THE OPTIC AXES CAN NEVER DETERMINE THE AMOUNT OF EYE-STRAIN.

It has often been observed that considerable manifest eye-strain may exist without materially inconveniencing the patient, or without inducing any noticeable nervous disturbance. From the fact that much smaller defects have apparently been the cause of excessive nervous disturbance, the conclusion drawn by some has been that these muscular defects are not responsible for the physical conditions co-existent with them. This

is erroneous and based on superficial investigation. A high degree of manifest defect, say 20 deg., may exist as in the case No. 1 ; but there is a great deal of the time during which the eyes are at rest in manifest troubles. Many times during the day, and always during sleep, there is no effort of the nerve-centers to parallelize the optic axes. The same amount of anatomical defect that we have just supposed may exist in a case where it is entirely latent. In this case the innervation that sustains parallelism is constant and fixed, and the strain is continuous. It is a constant source of nerve-center drain and irritation. Even during the hours of sleep the spasm continues, as in latent hyperopia. Otherwise, we should find, on waking a person from sleep, that the spasm of latent hyperopia had ceased ; but such is not the case. The same character of tonic spasm may exist in any of the long muscles as well as in the ciliary.

THE MORE MANIFEST A MUSCULAR DEFECT IS, THE LESS WILL BE THE STRAIN AND DISTURBANCE OF THE NERVE-CENTERS, FOR THIS FORM HAS PERIODS OF REST ; BUT NO PERIODS OF REST EVER COME, EVEN DURING SLEEP, TO NERVE-CENTERS THAT ARE SUSTAINING ABSOLUTELY LATENT EYE-STRAIN. THE HIGHEST STATE OF NERVOUS DISTURBANCE EXISTS WHERE THE DEFECTS ARE ABSOLUTELY LATENT, OR THEIR MANIFESTATION REVERSED.

The power of the eyes to fuse or overcome prisms held in various directions before the eyes, is much higher at the near point than at a distance. At twenty feet it may be difficult to fuse 2 deg. or 3 deg. of prism, whereas 6 deg., 8 deg. or 10 deg. may be fused in the same direction at a distance of ten or twelve inches. Cases will vary considerably, and no general rule can be laid down, but fusion power is always much higher at the near point. It is the high fusion power of the near point that I often find very useful in treatment. Fusion power is proportionately higher under a bright light, or one of high candle power, than under a weaker one. A plurality of objects, non-similarity of shape, variety of color and irregularity of arrangement, emphasize the fusion stimulus; on the other hand, any imperfection in the refractive media of the eye would dim or lessen the acuity of vision and the fusion power. A plain, blank surface offers no stimulus for fusion; a single point offers the least.

In utilizing fusion power to establish repressive strain, these conditions should be always kept in mind; acuity of vision, density of light, number of objects, and distance.

In testing with prisms, there is sometimes an objection to using a light. The field of vision is so sensitive in some eyes that the faint, doubly refracted image from the two faces of the prism

impresses itself on the retina of the patient, and this is mistaken for the second image of diplopia, which it is not. It is difficult, for this reason, to tell whether actual fusion has taken place. Consequently, in testing with prisms, it is safer to use some non-illuminated object to look at; but a light will be the most practical where the vision is foggy after an operation, or from other causes.

Again, when we think we have obtained fusion, great care should be taken to make ourselves sure that the two images are not so far separated from each other that one is thrown out of the field of vision, or so far into it as to cause it to be suppressed and only one object to appear. This precaution should always be taken.

An eye, to accommodate itself to a prism, always turns towards its apex. For this reason, in seeking to relieve and reverse the strain of a short muscle or to establish a repressive strain with prisms, we should always point the apex toward the short muscle.

IX.

ABNORMAL innervation of the ciliary muscle is very common. This muscle, surrounding the crystalline lens, exactly as the metal rim surrounds a spectacle, possesses the power to contract itself around the lens, thus increasing its antero-posterior convexities, and thereby raising its magnifying power, whenever that is deficient. This defect in the lens constitutes hypermetropia—or shorter, hyperopia—a condition in which the rays of light are brought to a focus behind the retina, or would be if there were a suspension of innervation. A stimulus for perfect vision, or a clearly defined impression in the visual centers of the brain, is awakened by the imperfect picture, and the impulse is sent through the ciliary nerves to the muscle, thus causing it to contract, so that the magnifying power of this little glass brings the rays of light to a perfect focus, producing a clearly defined image on the retina. The impact here sends impulses to the visual nerve-centers, giving rise to the feeling of perfect sight, which is the most instructive and the most continuously enjoyable of all our senses. If the crystalline lens possessed just the proper curvatures to bring

about perfect refraction at an infinite distance without any effort on the part of the ciliary muscle, it would still require an effort of this muscle to increase the refractive power for all nearer distances than twenty feet. This is called accommodation. Such an eye would be natural or emmetropic.

When imperfect vision is due to a deficiency of refraction in the crystalline lens, say 2 D, or when an eye whose vision is practically perfect will accept a 2 D spherical lens without impairment of vision, we have what is termed manifest hypermetropia to the extent of 2 D. We might well discriminate between these two forms of manifest hyperopia, naming the first Non-functional Manifest, and the second Functional Manifest Hyperopia, for the reason that in the first form, the function of vision is not perfectly performed, while in the latter it is. By using some drug to suspend the action of the ciliary, such as atropine, hyoscyamine, and their congeners, we may perhaps find that the same patient cannot see well with the 2 D glasses, but now requires 4 D, under its influence, to bring about the best possible vision. Without the drug, we had 2 D of deficiency of refraction; with it, 4 D. The 2 D is called manifest, the extra 2 D developed under the drug is called latent hypermetropia. It has been the aim of the profession always to deter-

mine the full amount of latent hyperopia. The advice given in all text books has been to put on the strongest convex glasses with which the patient could make out twenty-twentieths of vision, also the weakest concave glasses, thus recognizing the fact that it is always advisable to suspend as much ciliary strain as possible. This idea is not new, it is a time-honored method in all text books of the past as well as the present. The fact that mydriatics in some cases are variable in their action on the same patient at different times and under various conditions of health, is known to every oculist.

Latent hyperopia may exist to a high degree and yet be undiscoverable by the use of mydriatics. In many cases where mydriatics fail, fogging will reveal a high state of hyperopia. This relaxation of the ciliary by repression is often temporarily much enhanced by the administration of lobelia, wine of antimony, ipecac and similar general systemic depressants of the nervous system. Conversely, repression is retarded by stimulants.

In some cases of hypermetropia, hyoscyamine and atropine act, at different times, quite uniformly in discovering various amounts of deficient refraction; in others, their action is uncertain and variable to a considerable extent; while in some cases, these drugs have failed to give the slight-

est evidence of hypermetropia, which has been revealed afterwards by the process of fogging.

As in case No. 2, page 81, a two grain solution of atropine was dropped into the eyes twice a day for one week, as a test for hyperopia, but no hyperopia was developed. The solution was increased in strength to four grains to the ounce and continued for three days. The constitutional effect of the drug was so prominent, that I was obliged to discontinue it at this time. On examining the eyes, I again found no indication of hypermetropia. Vision without the glasses was twenty-twentieths or normal. I prescribed a +1 D glass for outdoor use, which gave twenty-fiftieths of vision at twenty feet. For house, reading, writing, and all close purposes, I prescribed a +4 D, which was 1 D more than an absolute suspension of the accommodation at thirteen inches. This rendered the patient artificially myopic. At the expiration of three months, through the +1 D glasses at twenty feet, vision was twenty-twentieths, and though the glasses were removed, vision continued normal, but when they were returned to the eyes, the vision through the glasses was reduced to twenty-thirtieths, and required about half an hour to regain its normal condition. I now increased the power of both pairs of glasses .75 of a dioptre, which again gave twenty-fiftieths of vision for objects at a distance,

and for objects at twelve inches the same amount of artificial myopia that the first pair of reading glasses gave. At the expiration of six months more, vision under the 1.75 D, at twenty feet, was normal. On removing these glasses, some five minutes were now required for normal vision to take place, indicating that the reduction of ciliary innervation was becoming somewhat fixed. The glasses were continued as well as the above modus operandi for a period of three years, since which time the patient has been wearing + 2.75 for all general purposes. With these glasses vision is twenty-twentieths at all distances, but for the purpose of resting the accommodation, a + 5 D is frequently resorted to for long and continued close work.

If serious nervous disturbances have been held in check by the above process, it is not advisable, after any given length of time, to prescribe glasses which will give fully twenty-twentieths of vision, but to increase their power .25 or .50 of a dioptre so as to produce about twenty-thirtieths, when practicable with the patient. Fogging fulfills a double purpose; first, the tendency to repress ciliary innervation is continued; next, the visual centers are relieved from taking impressions of numerous definable points, and great rest is often so attained.

Fogging, for the discovery of high degrees of

latent hyperopia where mydriatics fail, I believe to be entirely new. Naturally the criticism might be made that it would break down the accommodation. It certainly does break down a laborious accommodation that always exists where there is a high degree of latent hyperopia, which is making a constant and extravagant call on the nerve-centers. It breaks down a state of perfect accommodation that under highly abnormal conditions not only exists, but often proves very injurious to health. This is what it has always been our purpose to do with mydriatics. A new and more perfect accommodation is soon established, which is more favorable to conditions of health.

In such localities as England, the northwest coast of North America, and similar sections of country where during a great part of the time the atmosphere is humid and foggy, nervous ailments are not so common, because the sharpness of vision is much diminished by the haziness of the atmosphere, and the sight centers of the brain are not exercised to the same extent as in a clear, bright view, where the most minute objects are distinctly seen, and constantly taxing the nerve-centers with their impressions. For vision is an active function even when it is the easiest possible. It will often be found that besides repression, one of the results of fogging with

glasses is a state of rest and quiet, and sometimes sleep.

A question naturally rises here—Are the conditions which we are seeking to alleviate by repression of the ciliary, as well as by laborious attempts to repress the long muscles, of sufficient gravity to warrant the inconvenience to the patient? The reply must depend on the state of the patient's health.

Latent hyperopia is a condition of more or less perfect vision that is sustained by a constant and firmly fixed excess of innervation to the ciliary muscle. We will, in this immediate connection, consider myopia or near-sightedness, for I believe it properly belongs to the same line of thought. It is often the case that where the superior rectus is too short, the inferior rectus, instead of drawing the eye down to a balance with its fellow, draws it beyond, through an excess of nerve-force; and myopia is a condition depending at first on a similar spasm. In my opinion this defect takes its origin nearly, if not always, as hypermetropia, but the nerve-impulse that increases the convexity of the lens to correct the hypermetropia, exceeds that office; it passes the point where the refraction would produce clear and distinct vision, and near-sightedness is the result. It becomes an excessive impulse, fixed or progressive, arising from deranged nerve-centers.

Thus myopia is the result of a nervous disturbance which causes an associated disarrangement in the impulses of assimilation in various parts of the eye, especially in the sclerotic coat. This disturbance in the nutrition of the sclerotic and other parts, tending to soften them and lessen their mechanical support, together with the pressure of the rectus muscles, probably brings about that elongation of the eye that we find in axial myopia. The further these abnormal conditions proceed, the greater the source of irritation to the nerve-centers. In hereditary myopia, as in other hereditary diseases, there is undoubtedly transmitted a condition of the nerve-centers which tends to produce the difficulty. All evidence bears out the fact that myopes generally are people of a higher civilization, who exercise their eyes at the near point, and thus establish an abnormal impulse in the ciliary centers during such use of the eyes. The stimulus has been so constant for a long period that the impulse to the ciliary is unable to suspend itself and bring about distant vision again. The motive-impulse keeps coming. The ciliary will not relax from its contracted condition, the refraction remains high, and the patient near-sighted. This exercise of the ciliary centers through years, in one or more generations, causes a differentiation tending to produce an excessive ciliary impulse.

IN HYPEROPIA, THE NERVE-IMPULSE THAT CAUSES THE CILIARY MUSCLE TO CONTRACT AND INCREASE THE REFRACTION OF THE CRYSTALLINE LENS, IS ABNORMAL, YET IT PERFORMS A NORMAL FUNCTION; WHEREAS IN MYOPIA THE FUNCTION AND THE IMPULSE ARE BOTH ABNORMAL. The circular fibres of the ciliary are hypertrophied in hypermetropia; they are hypertrophied also in myopia previous to its becoming axial, but atrophied after it becomes axial, that is, when the eye begins to elongate; for this elongation necessitates the suspension of ciliary contraction to maintain distinct vision even at the near point. As the eye elongates, the repression that goes on in the ciliary is of the highest type, being exercised at the near point, thus suspending the action of the circular fibres of the ciliary muscle, and their atrophy naturally follows.

This natural forced repression, which increases with the progress of axial myopia, suspends the ciliary impulse more or less completely, and in such a case we should not expect those nervous disturbances that depend on ciliary strain; but in a a mixed case, where concave glasses are worn for all distances, and the ciliary is taxed with the accommodative effort of the near point, I have sometimes found that the removal of the concave glasses for reading suspended some accompanying nervous condition.

The following are some very interesting experiments in myopia which can be verified by any operator, and which prove that refractive myopia depends on ciliary spasm, and that, even in axial myopia, considerable repression can sometimes be made at the near point. In either class of cases, repression must be made at the near point. In various lengths of time, we shall be able to reduce the myopia one or two dioptres, sometimes more. In most cases satisfactory results will require considerable time and patience; but a few experiments after the following example will suffice to show that in some very advanced stages of myopia, it is possible to suppress, or at least check, its onward course by repression at the near point. This fact renders the fitting of minus glasses to myopic eyes an open question.

M. S., age thirty-five; has been wearing minus glasses since the age of twelve; obliged at various times to increase the power. When I saw the patient, she was wearing —5 D for all purposes. Vision with each eye, at twenty feet, was twenty-twentieths, or normal. The addition of half a dioptre increased the acuity of vision to twenty-fifteenths, or above normal. A reduction of the power of the —5 D glass to —4.75 reduced the distant vision to twenty one-hundredths. This glass was worn one week, and the vision, instead of having been improved, was reduced to twenty

two-hundredths. A return to the —5 D restored the vision to twenty-twentieths. Vision was also normal at the near point. On removing the glasses she was able in a few minutes to read ordinary type at eight inches, but no farther. Repeated tests for half an hour resulted similarly. A +3 D was now put on the patient, necessitating the holding of the type somewhat nearer to the eyes. After twenty-five minutes, she was able to read with +3 D at eight inches. After continuing them for an hour, and then removing them, the patient was able to read the same type at twelve inches; but this condition was of short duration, necessitating the gradual approach of the letters until, within five minutes, the type was again eight inches distant. Under the high fusion power of the near point, the ciliary spasm had become repressed or partially suspended while the +3 D glasses were before the eyes, and it did not return immediately on removal of the glasses; consequently the same print could be seen at twelve inches, but within five minutes the old innervation of the ciliary had re-established itself, necessitating the holding of the print to within eight inches again. At the far point, in this test, the fusion power was not sufficiently high to permit of a reduction of .25 D in the —5 D glasses. We see that it required fully twenty-twentieths of vision to bring about fusion power enough to prevent the

ciliary spasm from increasing, for when it was reduced .25 D the myopia increased rapidly in one week.

The patient was a constant reader, which it will be seen was a great aid to the results of my following effort.

I prescribed a +3 D glass for all reading. This continued for thirty days during which time no concave glasses were worn for out-door or distant purposes. When I again tested the vision for the far point, the patient could with —4.25 D, bring out twenty-twentieths of vision, being a reduction of .75 D in one month. The same trial was continued for another month with a still further reduction of .25 D, making in all 1 D in two months. During this time, some favorable changes took place in the condition of the nervous system. Just how far we could have succeeded in time in reducing this case of myopia, we do not know. Impatience and the inconvenience necessary to this procedure, influenced the patient at this point to abandon the effort. Neither is it possible to state just how much of this myopia was axial, which amount, of course, would not have been influenced by the repression process.

Age forty-three; myopia; had been wearing over the right eye —1.25 D, left eye —1 D, with little or no change for the space of two years; eyes in use more or less at the near point. I

recommended the removal of the concave glasses for distant vision and prescribed +3.50 D for reading, writing and other office work. After reading in these glasses for several days, the patient was able to read print twelve inches from the eyes. This patient was of more than ordinary intelligence and understood the aim of the effort. In six months I changed the glasses for reading and writing to a +4 D without seeing the patient. After using the +4 D glasses for several months he again came under my care for an examination, when the left eye gave twenty-twentieths of vision, while the right eye was very nearly the same, but the acuity was just perceptibly less. During this time the general health had improved somewhat, including considerable gain in the nervous condition. Similar results have been attained in thirty-four like cases; but the process is very tedious for the patients, and unless their understanding is clear on the subject, it is almost impossible to induce them to undergo the trial.

The foregoing in connection with limited tests of more than two hundred similar cases suggests an answer to that most important question, 'What shall we do to prevent myopia in school children and students?'

In a nomad, who is reared out of doors, who follows such pursuits that his vision is mostly used at twenty feet and greater distances, the nerve-

impulses to the ciliary muscle become established so that the easiest vision is for the far point, and in many years of such use, these impulses become more or less fixed; while the child of a higher civilization spends its life within doors, amuses itself with toys, picture books, kindergarten amusements and learning to read. We will assume that such a child generally holds its book or toy ten inches from the eyes, in which case the crystalline lens requires a much greater convexity, or higher state of refraction to bring about perfect vision; and this is brought about by an increase in the ciliary nerve-impulse which contracts the ciliary muscle. Through long continued use, this excessive impulse becomes comparatively fixed, and in some instances refuses to suspend itself sufficiently to bring about distant vision again, and so myopia has set in. The regular work of the student and those other pursuits which require the use of the eye at the near point, tend to perpetuate this disease and make it progressive.

Again, the important question, 'How are the advantages of a high civilization to be attained without the foregoing disadvantages?' If the eyes are to be used at a distance of ten inches, aid them artificially by a ten inch magnifying glass; then the nerve-impulses to the ciliary muscle will be no more than if the patient were leading an outdoor life and viewing objects at twenty feet

or more. The nerve-centers are not called upon for so excessive an impulse, and they become habituated to sending the same amount of nerve-force as if an outdoor life were led. In conjunction with this artificial aid to the ciliary centers, it may be found advantageous to suspend, in a measure, the excessive nerve-impulses to the interni, by the use of prisms, base in. Under these artificial conditions, the eyes may be used in the attainment of all the advantages of the highest civilization while the nerve-centers are no more taxed than if out of door pursuits were being followed. If the little student at school or any other person using the eyes at the near point, were to be supplied with such glasses during the hours of study, on leaving the school room they could be taken off and the natural use of the eye at all other times would be quite sufficient to cultivate and establish the habit of accommodation. At least the danger of disturbing the accommodation would be much less than the dangers resulting to the eyes and nerve-centers without such aid.

I simply suggest the above as a possible answer to one of the most important questions of the day.

Astigmatism, or that condition in which the refraction of the eye is different in various meridians. Illustration: In the horizontal meridian,

+2 D is required to correct the irregularity of refraction, while in the opposite or vertical meridian, +4 D is needed. Astigmatism is generally due to an irregularity of the spherical contour of the cornea, its curvatures being different in various meridians, requiring a stronger lens to correct it in one direction than the other. Corneal astigmatism is almost always due to the fact that some of the muscles of the eye ball are exerting greater tension in one meridian than another. For instance: A shortness of the internal or external muscle, inducing considerably more stress laterally than the superior and inferior muscles exert in a vertical direction, would cause the cornea to be distorted horizontally, and *vice versa.* The many possible varying conditions of tension in the muscles produce corresponding deformities in the contour of the cornea, resulting in various forms of astigmatism. Wherever corneal astigmatism exists, it is fairly safe to conclude that it is due to some muscular strain. After correction of muscular defects, it is quite common for large amounts of astigmatism to disappear, and leave the eye in perfect, spherical shape. In the foregoing remarks, I refer to corneal astigmatism only.

X.

THE short or stretched muscles never assume much if any normal action. They are always being stretched and relaxed again, consequently they are thin, attenuated, and undeveloped.

Under this irregular condition, the most delicate correlated action exists in the various movements of the eye, just as if perfect anatomical conditions existed. The nice relation existing between the accommodative effort of the ciliary muscles and the relative convergence of the optic axes to fix them for various distances, is maintained to a mathematical nicety. In exophoria, where convergence is performed by a contraction of the internal recti, and divergence is performed by a relaxation of the same, it is the amount of innervation sent to the interni that in part establishes our judgment of distance. In a marked case of esophoria or short internal muscles, where the act of divergence from the near point to parallelism is performed by an excessive contraction of the external muscles, and convergence to the near point by a relaxation of the same, it is the variation of innervation to the external muscles

combined with the effort of the ciliary muscles that determines our judgment of distance.

In esophoria, or convergence due to short internal muscles, where their length is such that the optic axes would be converged for a distance of ten or twelve inches during the absence of innervation, it is through the agency of nerve-impulse to the external muscles that the optic axes are drawn into parallelism for distant vision; and when the near point is again sought and the ciliary accommodation increases the refraction, it is not as has been generally assumed, an associated contraction of the internal muscles that converges the eyes; it is a negative action, a suspension of innervation to the external muscles.

The nice and delicate correlated action of the various parts of the eye has been assumed by some to be a delicacy of mechanical balance of the various muscles, but this is seldom if ever true. In nearly all cases, the balance is maintained by innervation which is the outgrowth of a stimulus in the nerve-centers for perfect vision. In such cases, the abnormal nerve-impulses have continued so long in the performance of their various duties, that they have become fixed impulses and they are virtually interlocked with each other.

There are numerous cases of defective eye-balance where short and abnormally innervated

muscles exist in one or more situations which seem to be firmly and most fixedly locked throughout, one with the other. To make myself thoroughly understood, I will assume to know just how much tendency to deviation there is in a given case in the absence of innervation. The left superior is short enough to cause the eye to deviate 6 deg. upward, and the two externals 20 deg. outward, while the ciliary is making up for 3 dioptres of latent hyperopia. All of these conditions are latent. Excessive innervation of the inferior muscle pulls the eye down against the short superior; abnormal innervation to the interni draws the eyes to a balance against the short externals, and the ciliary at the same time is making up the 3 dioptres of deficient refraction in the crystalline lens, until the function of perfect vision is the result, and all defects are hidden. It sometimes is a very tedious and puzzling problem to upset or unlock this correlated condition of abnormal impulses, and reveal the defects. If the abnormal innervation of one of these muscles can be interfered with and broken, there will be a general unfolding of all the defects. It is sometimes difficult to know where to begin. A few hours' or days' fogging may relax the ciliary spasm, and, after it has yielded, defects in other muscles will begin to manifest themselves; then development in that particular

direction may be taken up and followed until the condition of the eye is revealed with absolute certainty, by careful adherence to symptom tests.

Sometimes the ciliary spasm does not readily yield to fogging, in which case it may be easier to discover some defect in one of the long muscles, for illustration, the left superior. In this case an examination with dots or lights might show the two objects to be perfectly horizontal, or so nearly so that the patient could not discern that one light was higher than the other. By using a chart with a star or dot in the middle, and lines drawn horizontally across the chart both above and below the dot, equidistant from each other so as to represent for each space 1 deg. at the distance of examination. By the use of a 5 deg. prism, base down, first before one eye and then before the other, there will in each position appear to be two stars, with possibly four lines between the stars in each position. We then reduce the prism to 4 deg. and find the same result; then to 3 deg., where we may possibly find that a difference will manifest itself. That is, with the prism, base down,

before the right eye there will perhaps be two stars, while before the left eye there will appear only one. Or, if there be no difference with the 3 deg. prism, we resort to a 2 deg. prism, with which, if there is any difference, we shall discover it by there being perhaps two stars before the left eye with no lines between, while before the right there may be two stars with one line between; or we may have to use a 1 deg. prism before we find the difference, which will possibly be fusion before the left eye, while there are two stars with the same prism, base down, before the right. Perhaps even here the only difference that can be noted will be that the vision is much more perfect with the 1 deg. prism, base down, before the left eye and more indistinct in the same position over the right. We can then place in our trial frame a 1 deg. prism, base down, before the left eye. In ten minutes, more or less, the same eye will be able to accommodate itself for 2 deg., and a little later for 3 deg., 4 deg., and 5 deg., and so on up sometimes to 8 deg. or 10 deg. within an hour or two, while at the beginning the eyes could not accommodate themselves to 1 deg. or 2 deg. of prism in the same position. The surmounting of this difficulty will sometimes cause a tonic unyielding spasm in the ciliary to begin to manifest itself, where it would not readily do so as represented above by fogging. It may also

unfold some defect in the internal or external muscles.

We can with advantage oftentimes carry on repression in three directions at the same time. For instance, as in case 11, page 105, ciliary repression with +3D spherical, left inferior rectus 14 deg., base down, with 18 deg., base in. The suspension of repression in any one of these three directions in this case materially aggravated the symptoms. Inasmuch as fogging diminishes the fusion stimulus for the distance, we are often obliged to sacrifice some repression in this direction for the purpose of increasing it in another, or to increase repression in this direction by sacrificing it in another. Extraordinary care, patience and judgment are necessary at all times in the process of repression. Considerable variations in the condition of the nerve-centers ranging from depressed to more exalted states, often oblige us to retreat by reducing our prism in one or more directions for the purpose of remaining within the range of fusion. In some cases this will occur repeatedly, and at times may have a tendency to confuse us. Such circumstances should make us doubly careful, but should not deter us from attacking the same position again as soon as practicable.

The following is a continuation of the test of the vertical muscles where they will accommodate

for larger amounts of prism. It has been a common practice to use a 3 deg. prism, base down, first before one eye and then before the other. If fusion takes place in both these positions, the inference has been that there is nothing deficient in a superior or inferior muscle; but this conclusion is erroneous, for serious defects may exist without the above test giving the slightest indication of it.

When fusion takes place with a 3 deg. prism, base down, before either eye, we should next resort to a 4 deg. prism. If fusion takes place with this, we should then use a 5 deg., and continue to increase the power of the prism until the highest degree is reached where fusion will take place. It may be six, seven or even more degrees, and if fusion takes place before one eye equally with the other, there is apparently no difference as recorded by this test. If, on arriving for instance, at a 7 deg. prism we find it will fuse before the left and constantly refuse to do so before the right eye, we assume to have discovered a shortness in the muscle toward the apex of the prism where the highest fusion takes place, and the correctness of our inference should always be verified by symptom tests.

Now, before the eye that fuses for the highest degree of prism, we continue to add more, until we have reached the highest number of degrees

under which fusion will take place, which may possibly be ten or more degrees of prism more than the opposite eye would fuse for. If any such result is obtained, we should take off all prism for a time and repeatedly endeavor, by careful coaxing, to see if the eye that accepted the less prism can in any way be drawn to take on an equal amount with the other eye. If it persistently refuses to do so, we should then apply to the other eye all that it will accept. During this time we should constantly observe what changes, if any, take place in some prominent symptom or symptoms of the patient's disorder. If there be a marked change for the better in the action of the heart, or in some other condition, it is evident that we are turning the eye in the direction of the short muscle and repressing the abnormal innervation in the opposite; but if the disturbed conditions are emphasized as we proceed, it is very evident that the eye is being turned in a wrong direction and that we are being led on by a short muscle, the shortness of which is due to spasm and not an anatomical defect. In this case we are increasing the abnormal innervation and the irritation of the nerve-centers.

During our first efforts at repression we may not at once effect sufficient change in the disturbed conditions of the patient to assure us that our repression is correct, in which case we should

turn our test prism in the opposite direction; then if all the unfavorable symptoms be aggravated, we have some assurance at least that the last position was wrong, and therefore we return to the first position and proceed with caution and patience.

During all tests the color of the skin, the action of the heart, the warmth of the hands and feet and the general feelings of the patient should be carefully inquired into, for sometimes a spasm will turn the eye 8 deg. or 10 deg. in a direction opposite to the short muscle. The only safe way of discovering this spasm is to note the symptoms of the patient as we proceed, exercising at all times the greatest care in drawing our conclusions; for a pleasant stimulated feeling sometimes follows the turning of the eye in the direction of the spasm; but such a change is of a temporary character, and a few hours or a few repetitions of the experiment will suffice for the manifestation of unfavorable symptoms. Again, when we are developing in the proper direction, disturbances of a transitory character will sometimes arise, but these are not an aggravation of the symptoms of the disease. They should always be subdued. If we are really repressing, the probability is that the temporary disturbances arising are all new symptoms. The exceptions exceed any general rule that can be laid down in this practice, and

each case presents features that require individual care.

Sometimes we may be fortunate enough to have such marked changes ensue from repression that there will be little uncertainty. I have seen it reduce the heart's action within one hour from 120 to 65, where on the removal of the glasses the heart in a short time would increase to its former standard, and again with the glasses be reduced. I have repeatedly seen persistent pains in the back, the ovaries, the stomach and various other parts relieved within an hour or two, and reproduced by the removal of the glasses or the reversal of the prisms. I have seen the reverse position produce a nervous chill. There certainly is as much mental-suggestion in one position of the prism as the other.

There may be fully as much consciousness of effort in a repressive strain that suspends impulse as if it were a direct one requiring innervation to sustain it.

During repression, when the excessive impulse has been partially suspended, it will sometimes suddenly return, and with it the disturbing and annoying symptoms of the disease will be aggravated, but we must not be misled by this, for it is a thing of frequent occurrence. Abnormal innervation is very obstinate and is repressed slowly. The longer repression is persisted in, the

less likely is spasm to occur; but, when it does, the patient is unable to fuse any longer under the prism which was worn just before its return. In this case the prism should be reduced to a possible point of fusion again, for if the full amount is continued the fusion stimulus is lost and the spasm runs riot; but if the prism is reduced to that point where fusion can take place again, the spasm will be held more or less under subjection, after which we can gradually increase the prism again to the point where the spasm occurred, and in time get beyond it. These annoyances occur far short of full development, with only 2 deg., 3 deg. or 4 deg. of prism, where later the same case may develop 15 deg. or 20 deg. with much improvement. In excessively nervous people these spasms are quite frequent, but when we have discovered beyond a peradventure where the abnormal innervation is, we can force our position against all adverse symptoms.

As the ciliary spasm in hyperopia frequently passes beyond that point where perfect vision is the result, and too high a refraction obtains (myopia), so we may as often expect that the long muscles, in their effort to overcome some anatomical defect, have exceeded the intention of their effort to correct, and turned the eyes in a direction

OPPOSITE TO THE SHORT MUSCLE. THIS IS A REVERSE-MANIFEST EYE-STRAIN AND VERY COMMON.

When abnormal nerve-impulses have become thoroughly established through the medium of defects in the visual apparatus, and loss of sight occurs, all means of repression through the medium of the eyes is lost. If abnormal impulses depended upon a stimulus for their continuance, blindness would be the end of them; but inasmuch as these impulses become firmly and fixedly established, they will not suspend themselves without the interposition of repressive strain.

When eyes deviate from parallelism, the deflection is due to one of two causes, either a short muscle or a spasm. Again, the spasm may be due to an effort to correct a short muscle or to fixed abnormal nerve-impulses that are the outgrowth of long continued strained positions of the eyes, as in writing, reading, painting, mining, watchmaking and all kinds of labor where the eyes are in constant use at the near point, or in some unnatural position.

XI.

ORTHOPHORIA: Regular or correct tending of the optic axes.

Heterophoria: Different tending of the optic axes.

Esophoria: Inward tending of the optic axes.

Exophoria: Outward tending of the optic axes.

Hyperphoria: Upward tending of the optic axes.

Cataphoria: Downward tending of the optic axes.*

The above terms have heretofore been used in a relative sense; namely, esophoria, a relative tending of the optic axes toward each other; exophoria, a relative tending from each other; hyperphoria, in which the one axis is relatively higher than the other; and cataphoria, in which it is lower. A person with but one eye may have any one of the above conditions. The optic axis of a single eye may turn inward, outward, upward or downward from what would be a normal position, giving rise to considerable disturbance and strain, especially if

*We are indebted to Dr. George T. Stevens, of New York, for the above nomenclature.

a glass is worn, in which case the clearest vision is sought through its center, necessitating the holding of the eye in a normal position. If a glass is not worn, the head is usually thrown into that position which most relieves the strain. If the upper muscle is short, the chin is thrown down and the forehead forward; if the lower, the chin is thrown up and the head back; but if the short muscle is the outer or the inner, the eye rather than the head is usually turned so as to relieve the strain. These conditions are quite common in persons with but one eye, so I think it would be well to discriminate between relative and individual heterophoria.

By considering only the relative position of the two eyes, we are likely to overlook some grave defect in the ocular muscles, for it is possible for both of the superior or both of the inferior muscles to be short in connection with a relative deviation or a relative balance. Shortness of the external of one eye and the internal of the other may exist, and still a relative balance be maintained. We may often fall short in our investigation by taking into consideration only the relative position of the lines of sight. There are cases that should require months of careful investigation before safe conclusions can be drawn.

Defective length and defective attachment of the oblique muscles will sometimes be found. I

have met with two cases of this kind in which there was a very manifest turning of the ball on its antero-posterior axis when an effort was made to move the eye laterally. With the assistance of Dr. C. S. Hamilton, of Toronto, I operated on one of these cases by making a complete division of the superior oblique muscle at its ocular attachment with the result that the twisting movements of the eye ceased and there was very marked improvement in the nervous symptoms from which the patient had suffered previously.

From the fact of the convergence and divergence necessary for the accommodations for various distances, defects are much more likely to be manifest in the external and internal muscles than in the superior and inferior muscles, because during their functions there is never any deviation from a horizontal plane. Both eyes move upward and downward simultaneously and equally, and through such constant use the nerve-impulses to these muscles establish a very fixed horizontalizing tendency.

DIFFUSION TESTS.

Place a red or highly colored plain glass before one eye. The dissimilarity in color in some cases will disclose a lack of parallelism of the lines of sight.

A plus lens of 10 dioptres, more or less, covered with a disc with a small opening in its center which permits one eye to see only directly through the center of the lens, renders two lights so dissimilar in shape that diffusion will sometimes occur.

The Maddox rod placed before one eye distorts a light into a long beam of light, while the same object seen by the other eye retains its natural shape, and any manifest deviation can be discovered.

Another ingenious instrument for creating diffusion, is Mr. Brayton's Optomyometer, which consists of two hollow tubes about eighteen inches in length, through which the eyes of the patient look at a plain, smooth curtain or surface. When diffusion takes place two round spaces appear. These cylinders or barrels are so arranged that they can then be moved from their parallelism into a position that brings the two objects together, the degrees of deviation being measured by a pointer on the instrument. The fusion stimulus can be decreased in this instrument by adding any one of the above mentioned three implements to one of the eye barrels.

Direct the patient to look steadily at a light or some fixed object, covering one eye with a card. After a minute or two, suddenly change the card over to the opposite eye and inquire of

the patient if any apparent change occurred in the position of the light. Sometimes by this test we are able to see the eye move as it fixes itself on the light when the card is changed.

Place before the eyes enough prism, base in, to create diplopia, being careful that the axes of the prisms are horizontal and the head of the patient erect, and a single light or object appears as two, the object on the right side being seen by the right eye, and that on the left by the left. If either object appears lower than the other, the indication is that the eye on the same side is higher.

Place sufficient prism, base down, before one of the eyes to create diplopia, being careful that the axes of the prisms are vertical and the head erect, thus making a single light or object appear as two. If the lights are relatively vertical, there is an apparent balance; but if with the prism base down, before the left eye the upper object is to the left, there is a manifest convergence of the eyes; if to the right, a divergence.

Two prisms held together, base to base, by an eyeglass rim, if placed before the center of the pupil of the eye, with their axes horizontal, create for that eye two apparent objects. The other eye will see the real object between these two, if the prisms are of sufficient strength. If the middle object seen with the uncovered eye is higher than

the other two, then that eye is lower; and conversely, if the object is lower the eye is higher. If the prisms are not of sufficient strength, the uncovered eye may fuse its object with one of the other two images. By now turning the axes of this prism vertical, the two apparent objects are seen by one eye, one above the other, and any deviation of the middle or third object indicates a deviation in the lateral muscles.

This double prism test has no advantage over the single prism test, if indeed it does not possess one disadvantage, namely that of multiplying the objects; for the fact of there being two exactly in the horizontal plane offers a higher stimulus for the other eye to horizontalize, or bring its image into the vertical plane. There being two apparent spots exactly vertical, the stimulus to verticalize by the lateral muscles is emphasized.*

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*See horizontalizing and verticalizing tendencies, pages 37 and 38.

XII.

THE superior oblique muscle receives its nerve-supply through the Fourth Cranial nerve; the external rectus, through the Sixth; the superior, inferior, internal rectus, both obliques and the ciliary, through the Third.

That various parts receive their nerve-supply from the same nerve does not imply that their functions are necessarily similar, or that the governing nerve-centers are in the same locality; for two fibrilla in a nerve, lying side by side, may have the most widely separate origin possible in the nerve-centers.

Considered individually, the actions of the long muscles of the eye are as follows: The external rectus turns the eye outward; the internal inward; the superior, upward and slightly inward with a tortional movement of the upper aspect of the eye toward the nose. The inferior moves the eye downward, slightly inward with a slight tortion of the upper aspect of the eye from the nose. The superior oblique makes a tortion of the upper aspect of the eye toward the nose, with a slight movement of the optic axes outward and downward; the inferior oblique produces tortion of

the upper aspect from the nose, with a small tendency to turn the optic axes outward and upward.

Considered relatively, there are four antagonistic sets of muscles: First, the superior and inferior recti; second, the external and internal; third, the superior and inferior obliques; fourth, the superior and inferior recti as antagonized by the superior and inferior obliques. The latter set slightly diverges the optic axes, and the former set slightly converges them.

There are six sets of synchronously acting muscles: First, the superior recti turn both eyes upward; second, the inferior recti move them downward; third, the right external and left internal recti turn both eyes to the right; fourth, the left external and right internal recti turn both eyes to the left; fifth, the superior and inferior obliques of the right eye, acting together, in connection with the superior and inferior recti of the left eye, have a tendency to turn both eyes slightly to the right; sixth, the superior and inferior obliques of the left eye, acting synchronously with the superior and inferior recti of the right eye, turn the eyes slightly to the left.

A still further secondary action takes place as follows: When the eye is turned upward so that the relative equator of the eye-ball is thrown below the parallelism of the internal and external

recti, a contraction of these muscles will assist in turning the eye upward. Conversely, when the eye is turned downward so that its equator lies above the line of these muscles, their contraction will assist in turning the eye downward. When the eye is turned outward so that its equator lies inside the line of the superior and inferior recti, their contraction would assist in turning the eye outward. When the eye is turned inward so that the equator lies outside of the line of the superior and inferior recti, their contraction would assist in turning the eye inward.

In taking into consideration the chief action of any one or more muscles, the above associated movements should always be understood and considered.

XIII.

ESOPHORIA, or a tendency to a convergence of the optic axes, is the most deceptive and troublesome condition with which we have to deal, and from its very nature we can see how unreliable all diffusion tests are, as indicating the true conditions.

We will suppose a case where the lengths of the various long muscles of the eye are such that, without effort the axes of the two eyes are perfectly parallel at a distance of twenty feet or more. The muscles, in performing their functions at an infinite distance make their movements in various directions synchronously, the superior muscles turning both eyes upward, and the inferior muscles turning them downward. Turning to the right, the right external and the left internal act together, and the necessary innervation is compensated for when the two eyes are directed to the left; for then the left external and the right internal require an amount of innervation equivalent to that required for the movement in the other direction.

Supposing the various inclinations of the head to the right and to the left to be of nearly equal

frequency, the oblique muscles will also be uniformly exercised. Thus in the various movements of the eye at a distance, there is a tendency to establish more or less of an equilibrium in the nerve-impulses that contract the various muscles; but when the vision is fixed upon some object at a near point, as is necessary in reading, writing and in the pursuit of various mechanical arts, the internal rectus muscles receive an amount of nerve-force necessary to break the parallelism of the infinite distance, and turn the eyes toward each other. The repeated exercise of the internal muscles has a constant tendency to develop their power, and there is no counter movement of the eyes in which the opposing muscles have any opportunity for a like development. It is for this reason that we always find the internal muscles much stronger than the external; but the difference in strength between the internal and external muscles has no tendency to cause the eyes to deviate from perfect parallelism at a distance. Under normal conditions there remains the ability to suspend the nerve-impulse that gives greater strength to the internal muscles. When the eyes are removed from the near to the remote point the relaxation is a negative act yet a normal function. There is no contention between the internal and the external muscles. Under normal conditions, the function of suspending nerve-im-

pulse exists in all the ocular muscles; when certain muscles contract to perform some office their opposites relax to assist them. In the fullest sense this suspension of nerve-impulse is probably not absolute. Just sufficient impulse continues to give the eyes a steady position; but, where the employment of the eyes has been such as to necessitate their use at the near point constantly, from morning until night, day after day (as in the case of an inveterate reader or writer, or an artisan with his work constantly close to his eyes), the nerve-impulses of the internal muscles are almost constant, with little or quite infrequent periods of relaxation; thus the impulse becomes such a fixed and constant quantity that ultimately there is an inability to suspend it entirely. Such eyes, when examined at a distance of twenty feet or more, show a positive tendency toward convergence, while at the near point we may find a balance, a convergence, or even a tendency to divergence, as a result of the excessive abnormal innervation.

By diffusion tests a convergence may appear where the external and internal muscles are of proper length, when it is apparent esophoria; or it may appear where the externals are short, in which case it is a reverse manifestation; or it may appear where the internals are short. Of the three conditions, the last is the least likely to be the fact.

ESOPHORIA is the most confusing and obstinate condition with which we have to deal. The above demonstrates how dangerous it is to rely on any diffusion test as an indication of the true anatomical condition of the ocular muscles; and it is not strange that, by so doing, many have been thrown into doubt and confusion as to the importance of this field of work. Repression, in which symptoms are our chief guide, is the only method of safely determining whether the diffusion tests have given a true or false indication of the condition of the muscles. The majority of cases of manifest esophoria are reverse manifestations, or due to spasm. When esophoria exists at the far point, and exophoria at the near, it is pretty safe to conclude that it is not true esophoria.

EXOPHORIA.

Of all defects, this is undoubtedly the most common. The tendency of the optic axes to diverge may, as in other muscular defects, be due to shortness of the external muscles, or it may be apparent exophoria, due to spasm, receiving its initial source of irritation from a latent defect in some one of the other muscles, more usually a superior or inferior. Or, it may possibly be a reverse manifestation. In short, strain in any one of the ocular muscles may give rise to a spasm and apparent defect in any of the others, and

repression is the only method that will determine with any safety the actual state of affairs. Whenever exophoria exists at the near point, I always endeavor by repression to develop an exophoria and in most instances succeed. Also in some cases where esophoria exists at the near point, repression will develop a true exophoria, the certainty of which is rendered positive by the physical relief which accompanies the development.

HYPERPHORIA AND CATAPHORIA.

A greater amount of defect is likely to be latent in the superior and inferior than in the external and internal ocular muscles, for the latter in the performance of their various functions are alternately converging and diverging their optic axes, while the superior and inferior never cause any relative change in the optic axes, upward or downward, during their work. Whatever position they assume, the optic axes never deviate relatively from a horizontal plane; consequently the impulses to the superior and inferior muscles become more obstinately fixed, and defects in these muscles are less likely to manifest themselves. If the superior muscle of one of the eyes is short, and the inferior muscle of the same eye is sufficiently innervated it will draw the eye down into line with its fellow. Day after day nerve-impulse is sent to the inferior muscle, contract-

ing it and holding the eye in place. During months and years this process goes on until the nerve-centers become accustomed to manufacturing and sending out this excessive nerve-impulse, and perfect vision is performed. At the age of thirty, more or less, the short muscle, having been constantly kept on the stretch, is naturally weak and undeveloped. Its length is greater than normal conditions would have left it. It has always been stretched by the opposite muscle, which has contracted to draw the eyes into line, while the contracted or innervated muscle is over-developed, having received for thirty years an excessive amount of nerve-impulse to perform its work, an amount of motive-force for which the nerve-centers were not originally intended to be drawn upon. In time, through differentiation, the nerve-centers become accustomed to generating and sending out this excessive amount of motive-force for the purpose of maintaining perfect vision; thus the impulse becomes a fixed one requiring no further stimulant to call it forth. It becomes fixed in sufficient force to establish a balance between the two eyes even when prisms or other diffusion tests are resorted to for the purpose of ascertaining if one eye is higher or lower than the other. Although we have created diplopia, the eye does not turn toward the short muscle, because the nerve-impulse that opposes it

pulls just as hard as the short muscle does. It has become an absolutely fixed impulse requiring no stimulus to generate it. It is as fixed as the impulse that carries on the action of the heart or the functions of the liver. Under these circumstances it is useless to expect any diffusion test to reveal a muscular defect if it is present.

From this excessive demand for motive-force irritation frequently results in the centers that are furnishing it; the impulse becomes stronger than is necessary to hold the eye down in line; and, when diffusion tests are made, it is pulled below or in a direction opposite the short muscle (reverse manifestation). To attempt to correct such a defect as manifested by diffusion would increase the nervous disturbance. Repression in connection with symptom tests is the only safe procedure.

During repression by crowding on all the prism that the eyes will fuse under we cannot expect this short muscle in a few weeks or even months to assume its normal length. Will it be as short as it would have been had it never been stretched; or would the opposite or excessively innervated long muscle under this process become stretched to a length that is in any way equivalent to the stretching that has taken place in the short muscle during a period of thirty years? This question is a sufficient answer in itself.

When we have discovered that a defect exists

in the superior or inferior rectus muscle, it is important to determine whether it is hyperphoria or cataphoria; for to select the superior muscle as being invariably the defective one will prove wrong. Dr. Stevens has pointed out the fact that the head is usually tilted toward the shoulder opposite the eye which tends the higher; in other words, it is tilted toward the shoulder on the side next to the eye which tends the lower, or would in the absence of innervation. Now, it is very important to determine whether this tendency is due to a short inferior muscle in one eye or a short superior in the other. This I think can safely be determined by noting another position of the head. If, in connection with the side inclination, the head is constantly thrown backward and the chin elevated, the inferior muscle will prove to be short; but if it is inclined forward with the chin resting well down toward the breast bone, it is evident that the superior muscle is short. These positions should be carefully noted during repression tests, and if the chin is thrown up and the head back, the greater amount of our repression prism may be put on, base up, which will have a tendency to lower the chin. If the head is ducked forward, we may put on the greater amount of repression prism, base down, which will have a tendency to raise the chin into a more normal position.

Before operating on an eye the oculist should determine several important things. First, is the patient's condition a serious one, and does it in a great measure depend on eye defects? The result of our examination by repression will determine this for us, for if prominent symptoms can in this way be subdued, we have reason to feel encouraged. Next, have the tests developed a sufficient defect in the ocular muscles to warrant an operation? If the defective muscle is a superior or inferior, and the repression has not disclosed more than 10 deg. or 12 deg., treatment with prisms may be the more practicable. This in no way relates to defects as developed by diffusion tests. In a case in which no more than 10 deg. or 12 deg. have been developed by repression, partial tenotomy might possibly bring the optic axes up or down into line; but it would not leave as true normal conditions as prisms. A partial tenotomy in which three-fourths, more or less, of a tendon is divided leaves the other one-fourth of the tendon on the stretch. It offers less, yet a proportionate amount of resistance. If it permits the eye to turn sufficiently far, the cut fraction may assume in a small measure the functions of a normal muscle, but this is forever out of the question with the uncut portion.

If the muscles are so attached to the ball that one of the eyes deviates from its fellow 20 deg.,

when the eye is in this position the muscles are of proper length and all innervation will be suspended; but when this eye is moved into line with its mate one muscle is too short and the other too long; consequently, if the deviation is within the practical limits of the use of prisms, the eye is rotated into that position in which both muscles are of proper length, and from this position the associated movements of the eye will call upon each muscle for its proportionate share of normal function.

If primarily an eye had a tendency to deviate in any direction—for illustration, outward one-fourth of an inch—and innervation to the opposite muscle has lined the eyes up and held them in proper position for a space of years, during this time the short muscle has been stretched to one-fourth of an inch greater than its natural length, while the long muscle, by contraction, has taken up one-fourth of an inch of excess in length. Under these conditions the short muscle is longer, and the long muscle shorter one-fourth of an inch than they would have been had their lengths been normal primarily. Therefore, under these circumstances, a lengthening of the short muscle by tenotomy does not by any means fulfill all the requirements of the case. It is true that the short muscle needs greater length; but, for a normal position of the eye, we must remember, also, that

the opposite muscle has always been too long; and if we relieve the strain in the short muscle, thus allowing the eye to maintain a normal position with less work, the long muscle on the opposite side must contract upon itself by excessive innervation a sufficient amount to shorten itself one-fourth of an inch before it can assume normal functions; and the necessity of shortening this muscle to avoid this innervation is oftentimes as necessary as the lengthening of the short muscle. When a short muscle has been stretched by its *vis-a-vis* for many years, and an operation is performed which gives it greater length and removes the stress upon it, the short muscle that has been stretched begins to shorten itself after the operation by assuming a normal activity that it never before had an opportunity to assume. After the operation the short muscle has a chance to act for the first time in its existence. It continues to shorten week after week, month after month, and will usually take up several degrees of deviation made in the opposite direction by the operation. This process of shortening continues to such an extent that in variable lengths of time it will obliterate double vision to the amount of 10 deg. to 20 deg., and often a deviation in the original direction will ultimately present itself again, requiring still further correction by a repetition of the operation. Often it is deemed necessary to

lose a limb to save life, and the little temporary discomforts and inconveniences resulting from repression should be looked upon in the same light. After external tenotomies, double vision will sometimes continue to exist for several months, in looking to the extreme right or left, a condition that need not annoy the patient at all. This seldom follows tenotomy of the internal muscle. With care in developing fully, and continuance of the repression under prisms for several weeks, complete tenotomy can be performed in the majority of cases without the occurrence of double vision. If the development has been high and double vision does occur, it soon corrects itself by the normal shortening of the cut muscle.

Never should an operation be performed until the physician is absolutely certain that he has ascertained which muscle is short. An oversight of this kind might occasion very serious consequences to the patient.

From the above conditions we can see that the results will be but temporary in an effort merely to balance the optic axes where there has been a manifest deviation. If we balance them for the time being, the process of shortening the already short muscle will in time tend to reproduce deviation in the same direction, and it will keep on doing so from time to time, necessitating many operations; indeed I have known as many

as twenty. Life is too short for such a procedure, when by repression we can more rapidly discover the latent defects. In applying the maximum of prism under repression, and turning the eye toward the short muscle, we enable it to assume some normal action. It also begins to shorten. Before operating it is best to wait, if time is at our disposal, until the muscles have correlated themselves to this new position. Then a tenotomy has less tendency to turn the eye in the opposite direction and create diplopia. The ultimate outcome of immediate tenotomy that creates double vision, and of tenotomy after a new correlation has been established, will be the same; but in the latter case the inconvenience to the patient would be less immediately after the operation. In the case of the lateral muscles, complete tenotomy is not advisable if repression development has not reached 15 deg. or upwards, and in the case of the vertical muscles it should have reached 12 deg. or more. In any deviation of the axes amounting to less than the above, my advancement operation with a ligature plate will bring about the small change of position needed with much more precision than tenotomy. Even in higher amounts of deviation, advancement with the ligature plate will fulfill the normal conditions in some cases more perfectly than tenotomy,

especially in eyes that are large, prominent, and apparently very loose in their capsules.

In developing a short muscle by repression, it is safe to conclude that, if we force it to its highest point for several months, we shall not be able to develop the muscle even then to as short or as near a normal condition as it would have been in had it not been stretched for thirty years or more. Just how much the short muscle has been lengthened and the long muscle shortened, during this long period of stretching, it is not possible to determine at once; but it is absolutely safe to conclude that in keeping the eye turned toward the short muscle as far as we can for a few months, we shall not stretch the long muscle as much as the short one has been stretched.

When guided by symptoms and certain that we are right, we need have no fear of going too far with our repression, if it be continued for many months. Where from the time of birth the short muscle has been constantly stretched for thirty years, it will probably never be possible in the lifetime of the patient to make the muscle as perfect by repression as it would have been had it not been too short at the beginning. In the course of a few weeks, I have often discovered more than 50 deg. of latent defect, where none, or at most 2 deg. or 3 deg. was at first manifest

by all diffusion tests. The method of merely balancing such manifest defects with prisms and operations can afford only temporary relief, and a small amount even of that. In a short time after all such corrections, a little more of the latent defect manifests itself, requiring still further correction, and it continues to develop itself after each correction again and again through a long period of time; on the other hand, repression enables us to arrive at the desired end as quickly as possible, and perhaps lengthen, by many years, a life that would not have lasted through the slower process. In those cases where the most marked relief has followed tenotomies that brought about an immediate balance, I conceive that the eye has moved several degrees farther than the manifest deviation, but still just within the broad limit of the verticalizing and horizontalizing function exerted under diffusion tests.

XIV.

THIS work is entirely confined to latent eye defects and the repression of abnormal nerve-impulse, and in no way is it intended as a text book on refraction or ocular surgery. Only one operation is set forth, because it is new. I think it offers many advantages over all others for the advancement of the recti. In all advancement operations the tying of the ligature is a question of judgment, and at the best we can only approximate the required change of position. By such operations we can never hope to obtain anything like absolute accuracy in the change of the position of the eye, for the small difference of one millimetre may mean several degrees of deviation of the optic axes in one direction or the other. By my operation with the ligature plate, the desired position of the eye will be attained with much greater accuracy.

The ligature plates are made of aluminum. They are about three millimetres in width, vary in length from about four millimetres to twelve or more, and weigh from one-eighth to three-fourths of a grain. They are spherically curved so as to fit the contour of the eye, their curva-

tures being in varying diameters to meet the requirements of different sizes of eyes. The plate is slightly notched at each end, with a groove running from each notch its entire length on the convex surface, into which the ligature falls and is out of the way of producing any irritation.

An incision is made through the conjunctiva and capsule of tenon in the direction of the muscle, and extending along its middle line, beginning at its scleral attachment and extending as far as may be necessary. The muscle should then be entirely freed from its capsular and ocular attachments. A Stevens' hook is then passed behind the muscle and traction made toward the cornea; another hook is now passed behind the muscle from its opposite side and traction made in the opposite direction at the same time. The point of the second hook should be forced outside of the capsule so as to expose the muscle to view; a small curved needle carrying one end of a ligature is made to enter one margin of the muscle as far back from its scleral attachment as is necessary, pass, as nearly as possible, transversely through its fibres, and come out on its opposite margin. This engages many more fibres of the muscle than the passing of the ligature directly through it. It also offers a much greater support to the ligature, there being much less likelihood of its tearing away; in fact, it never

has torn away in my experience. After the ligature has been so far placed, a portion of the muscle can be cut away if it is deemed advisable. Unless the amount of advancement be very considerable, more than six millimetres, or one-fourth of an inch, the operation will generally prove fully as satisfactory without cutting the muscle. Each end of the ligature on its respective side is passed from the under side through the margin of the muscle close to its scleral attachment. After the two ends of the ligature have been brought through these parts of the muscle, the hooks are taken out. Each end of the ligature on its respective side is now brought through the conjunctiva from its under side, at a point about three millimetres in the direction of the cornea, from the scleral attachment of the muscle and about eight or ten millimetres apart, which the width of the scleral attachment should determine. The exits through the conjunctiva should be from three to four millimetres wider apart than the width of the scleral attachment. The two ends of the ligature should now be carefully tied by a surgeon's knot, not drawing the ligature so tight as to draw or pucker up very much the conjunctiva that it engages. Not much drawing forward of the muscle should be attempted in the first tying of the ligature, it should be just tight enough to insure the taking up of all slack

in the ligature. Or, where the conjunctival exits of the ligature were about eight millimetres apart, the tightening should be sufficient to draw them within about four millimetres of each other. The knot should be very carefully and firmly tied. Two strabismus hooks may now be used or a ligature dilator made for the purpose, and the muscle may now be advanced by traction in opposite directions. By this process the operator can now see about what length of a ligature plate should be used; accordingly he firmly seizes the plate with a pair of forceps made for the purpose, and makes one of its notched ends to engage one side of the ligature. A somewhat strong Stevens' strabismus hook is now used to make traction on the opposite side of the ligature, and to slip it over into the notch on the other end of the ligature plate. The forceps and hook are now removed and the ligature and knot fall into the groove on the ligature plate, so that there is no possibility of its coming in contact with the conjunctiva and giving rise to even that amount of irritation that an ordinary ligature does.

An examination can now be made to ascertain the exact position of the eye and the amount of advancement that has been accomplished. If it is not sufficient, a ligature plate of greater length can be made to replace the first. If too much advancement has been made, a shorter ligature

plate can be used. The ligature plate of a proper shape and carefully made never gives rise to the slightest irritation; its presence is not even felt by the wearer. It should be left in for three or four days.

When the operation is made without cutting the tendon, the muscle is tucked or folded upon itself, and the inflammatory action that follows fastens it in this position. The slight bunching or enlargement that results from the folding soon entirely disappears by absorption. After that stage of the operation where the ligature has been passed through the muscle the first time, a portion of the muscle can be cut away if it is deemed advisable. Unless the amount of advancement is very considerable, the operation will generally prove fully as satisfactory without cutting the muscle. By this operation I have changed the position of the eye 30 deg. without cutting the muscle.

Modifications of the above operation can be advantageously made in which this plate is still very useful. Where the conjunctiva is sufficiently strong to withstand the necessary traction, that stage of the operation where the ligatures are passed through the muscle at its scleral attachment, may be left out, so that, after the ligature has been passed through the muscle far enough back, the two ends may be brought out through the

conjunctiva on their respective sides, eight or ten millimetres apart, as close to the cornea as possible. If the conjunctiva is sufficiently strong to stand the dragging, the ligature plate prevents it from puckering up, and offers the advantage of increasing or lessening the effects of our operation, at the same time hiding the ligature from any touch with the palpebral conjunctiva. In all the old operations, after the ligature has been tied, if the position of the eye is not satisfactory, any alteration involves a new ligature and another operation; whereas with the ligature plate these alterations can be made by substituting plates of different lengths.

XV.

IN refutation of the possible claim that the results in the foregoing clinics are due to "suggestion," I deem it advisable before concluding this work to say something on the subject of hypnotism, although it is a digression from the subject under consideration. I do not propose to enter any denial as to the remarkable phenomena that are exhibited in various hypnotized subjects. These are established and undeniable facts. The entire investigation of the subject of hypnotism has been confined to a study of its effects on the hypnotic subject. Prevailing through all of this has been the general superstitious idea that some mysterious force passed from the operator to the person operated upon, or from the stronger to the weaker mind; while there has been little or no effort in the direction of determining what the actual physical causes were that brought about these results. The easiest subject for hypnotism is the neurasthenic, whose general supply of vital force for various functions is very limited. Like a dynamo, the nerve-centers are capable of generating a given amount of vital force. In persons suffering from nervous debility, the supply of

nerve-force is restricted and is not sufficient to carry on with vigor the various functions throughout the animal economy. We must remember that thought or ideation, of whatever nature it may be, is a process that requires nerve-impulse for its performance; also, that a pain consists of an abnormal nerve impulse.

"Suggestion" that gives rise to the so-called hypnotic, psychologic or mesmeric condition may act through the medium of any one or more of the five senses.

If a person in possession of a valuable treasure were to enter at night an isolated house which he had every reason to believe was unoccupied by any other person, and while slowly feeling his way in the dark, from room to room, should suddenly feel a hand placed on his shoulder, a radical change would at once take place in his nerve-centers, and such a change would be greater or less according to his condition and surroundings.

If a person who was familiar with the taste of various poisons were to enter a dimly lighted apothecary shop and carelessly swallow a dose of something supposed to be a sweet cough mixture, and the dose suddenly proved to be intensely bitter, he might at the time think he had taken a dose of strychnine, and a change in the action of the nerve-centers would take place, commensurate

with the condition of the person and his surroundings. I have known such an accident to produce complete prostration; but when it was learned that the bitter dose was quinine, the recovery was rapid.

The smell of smoke in a high building with insufficient means of egress might suggest the idea of a horrible death by fire, and varying conditions would result in the nervous systems of the persons so frightened.

Through the medium of the sense of hearing very potent changes in the nervous system are brought about. One Sabbath morning many years ago I was sitting on the veranda of a hotel in the South, when suddenly I heard a most terrific and unnatural sound, the building trembled violently, the air seemed dense and oppressive. For the moment I was helpless, I could not think, I could not move; the horrible, weird strangeness of the sound had suspended my functions of volition and reason. The time was but a moment, but it seemed many to me; then I saw falling by me to the ground the mutilated form of a man. This recalled me somewhat to my senses. There had been an explosion.

Remarkable changes are aroused in the nerve-centers through the medium of vision; intense feelings of pleasure, pain or fear are induced by

"suggestion" through this medium. The lover of nature is hypnotized as he looks upon some strangely grand or beautiful scene; "suggestion" from the inanimate surroundings has influenced the action of his nerve-centers.

Complete prostration and often unconsciousness are induced by something that is seen. The changes that are wrought in the nervous system by the strange and fantastic "passes" or "movements" that are made by the so-called mesmerist, hypnotist or psychologist are no more due to a force or entity that passes from the operator to the subject, or from the stronger to the weaker mind, than the similar mental conditions mentioned above are due to the transference of a similar entity or force. Inasmuch as similar effects are brought about by inanimate surroundings, it is evident that there need be no transmission of a force to produce the hypnotic state. The interesting and amusing phenomena that are brought about by "suggestion" are commensurate with the weakness or excitability of the nervous system of the subject.

After the "suggestion" all the changes or phenomena that take place in the subject are due to the action of forces in his nerve-centers. A belief that there is some mysterious force sent out by the operator or the stronger mind is very

foolish and dangerous, for persons so believing are easy subjects, and become victims of persons of evil design.

When the imagination is sufficiently excited by "suggestion" there is so excessive a call upon the nerve-centers for vital force to sustain the exalted ideation, that all other functions for the time being are robbed of the limited vital impulse with which they were previously supplied. The nerve-impulses that gave rise to the functions of feeling, motion and reason are perverted; and where pain existed the abnormal impulse that gave rise to it has been turned aside and utilized in the strong imagination that has been awakened. The subject is utilizing all his feeble vital forces to maintain an excited mental condition that has been aroused by "suggestion," which may be by the word of mouth, motion, general surroundings or exciting events. Where pain is relieved by hypnotism, it is because the impulse that gave rise to it has been perverted into this new channel. Where the function of feeling is suspended, it is because the vital forces have been so drawn upon that there is not sufficient left to give rise to the function of feeling. Where the reasoning faculties are so perverted that one can be made to believe and apparently see things as they are not, it is because the excitation has so utilized the vital forces that there is not sufficient left to

assert reason, and whatever is suggested is accepted as truth. Hypnotism or "suggestion" is the diversion into other channels of those nerve-impulses that give rise to feeling, motion or reason, the turning of them aside from the performance of normal functions to execute another kind of work.

It is on this principle that a mustard plaster or any other counter irritant acts: it turns aside the nerve-impulses that gave rise to pain and utilizes them in the secondary or induced irritation.

"Some ideas are suggested to the mind by all the ways of sensation and reflection."—(Locke.)

"Suggest: To introduce indirectly to the thoughts; to cause to be thought of, usually by the agency of other objects."—(Webster.)

When a person steps upon a tack it suggests thoughts and sometimes words that are very emphatic; the savory smell of a broiling mutton chop will often suggest hunger; the whistle of a locomotive suggests that more haste will have to be made or the train may be missed; whenever I hear a certain piece of music it always suggests to me the lovely Jepsom Gardens and the Holly Walk at Leamington on the river Leam, for it was there that I first heard this music; the taste of some delicious viand often suggests some other time and scene where this flavor awakened a

more than ordinary degree of pleasure; seeing another put on his gloves and hat might suggest to a man that it was time to go home. "Suggestion" in its fullest sense is susceptible of a very broad definition.

"Hypnotism," a word of Greek derivation, and meaning sleep, is at present used in almost as broad a sense as the word "suggestion," and many of the mental states that result from "suggestion" are denominated "hypnotic." The average mind is quite as open to "suggestion" in the present day as it has been in all ages past. It is not capable of reasoning for itself. It generally follows out certain lines of action because they are conventional or have been "suggested" by others. A collegiate training is valuable to those minds that are capable of receiving it, for it imbues them with formulated methods of analysis and action, which methods are the products of reasoning minds that have thought for the benefit of others. What is called original thought comes to but few. "The power of stepping out of the beaten track of thought, of bursting by a happy inspiration through the bonds of habit and originating a new line of reflections, is most rare, and should be welcomed in spite of its sometimes becoming extravagant."

At present the people in several sections of our great republic are running wild over the

question of hypnotism. Many of these unthinking minds have been led to believe that whenever a buffoon raises his hands and makes certain meaningless motions, they are bound to become helpless and follow whatever suggestions he may make. Excessive fear and awe are the results of this belief, and an exalted excitation of the nerve-centers results, which may actually produce what is called the "hypnotic" state; but where this belief does not exist, and where there is an unbelief as to this mysterious force, however weak the subject may be, these methods fail to hypnotize.

I remember a mesmerist who several years ago was lecturing in a small town in Ohio. He had succeeded in exciting quite a large number of the community. The audiences of his nightly lectures grew until the opera house would barely hold them. He was very much reassured by his success and invited the opinion of any member of his audience. A professional gentleman walked to the rostrum and set forth, in a very clear and concise manner, opinions similar to those given in this chapter. From that time his so-called hypnotic power ceased, and of the ten subjects on the stage who had been obeying his suggestions, there were but two who continued to do so. These were strangers to the community, and I afterwards learned from one of them that they were both

under his pay at a salary of $15 per week. It is not necessary for a hypnotist to resort to this trickery, for if a firm belief in the mysterious force exists in a person with a weak nervous system, he can undoubtedly be hypnotized. It is now high time for thinking professional men to come to the assistance of the unthinking masses, and teach them that it is as unnecessary to yield up reason and thought to the gyration of the hypnotist's arms as to the whirling of a merry-go-round.

Horses are almost universally hypnotized when a barn takes fire. Invariably they refuse to leave their stable. It has always been their place for feed, drink and rest. In their thoughts it is most safe and comfortable of all. Under the exalted excitement of the nerve-centers of the animal, all other instincts vanish.

I have a number of chickens which were hatched last spring and had never seen the snow until this winter. On a Friday evening one perched itself on an elevated portion of the hen house. During the night a heavy snow fell. On the following Tuesday evening my neighbor came in to tell me that there was a hen standing on top of my hen house and that it had been standing there for four days. At least, every time anybody looked out of the window, the hen was seen standing in the same position, and it was inferred that she must have been standing there all that

time. I became interested, at once went into the back yard, crawled on to the roof, and approached the hen. She paid not the slightest attention to my presence; she seemed perfectly unconscious of all surroundings. As I stretched my hands toward her, she did not move, but after I seized her, she at once began to squawk.

In looking from a high tower or precipice some people experience a feeling allied to hypnotism. Wonder, awe and fear so utilize the vital forces that reasoning and self-control are temporarily gone. The many so-called suicides committed by jumping into Niagara Falls or from high towers, are acts committed in the hypnotic state; at least, I believe a great mistake is made in indiscriminately calling such acts suicide. It is a notable fact that all high towers have to be protected so that people cannot jump from them. The Washington Tower, the London Monument, the Eiffel Tower, the dome at the Capitol of Washington and many others have had wire network or other apparatus put up to prevent persons from jumping from them. I think it is a grave injustice to call all such acts suicide.

It is perhaps a mistake to allow the word hypnotism to assume as broad an application as is now popular. In this sense every speaker, every preacher is a hypnotist. Each suggests his good thoughts from the pulpit or the rostrum and

endeavors thereby to influence his hearers. The successful jurist by rhetoric, oratory, earnestness and gestures, hypnotizes the jurymen until tears mark the result. Every business man, every solicitor utilizes, to his utmost, his power of suggestion, for the sake of influencing his customers.

What I wish particularly to point out in this chapter is that there need be no transference of a mysterious force from the operator to the subject to bring on hypnotic states, inasmuch as inanimate surroundings can produce a similar effect.

Considered in the line of the above hypothesis, the changes that take place in so-called "faith cures" are easily accounted for. It is probably a fact that many deranged functions have been restored to more normal action through an effect on the nerve-centers brought about by "suggestion" in the form of Christian Science, hypnotism, or faith cure. We are fully aware that fright is often the exciting cause of deranging the nerve-centers to the extent of disturbing some important function. Fright has also been known to restore to normal action a disturbed function. In aphonia, which is of frequent occurrence in certain individuals suffering from nervous debility, the power of speech has often been restored by some person approaching the patient unobserved, suddenly making a loud sound close to the ear, and so causing fright.

This switching or transference of nerve-impulse may possess some value in scientific hands, but in no way does it fulfill the requirements of enfeebled or insufficient nerve-centers. The true end to be sought is vigor and equilibrium of action in all the nerve-centers, so that all functions may receive a normal share of nerve-impulse for their performance; a result which is hardly to be expected from suggestion or faith alone. A fair average of success in this direction is illustrated in Walter Scott's "Waverley," where the Scotchman tried to teach his mule to do without food. He gradually reduced the poor animal's feed until he ate but one straw a dav, when he died.

Again I repeat, hypnotism or "suggestion" is the diversion into other channels of those impulses that give rise to feeling, motion and reason; it is the turning of them aside from the performance of their normal functions to execute another kind of work.

That the favorable results brought about by repression are not due to "suggestion" is evident from the following illustration. A person requiring a prism in a certain position for repression is materially relieved while the prism is in the proper position. If, *without the knowledge of the patient*, the prism be reversed, all the unfavorable symptoms will be materially aggravated, while

the "suggestion" to the patient is the same with the prism in one position as the other. Such tests can be repeatedly made on patients under repression, and the results are uniformly the same. The proper position of the prism always relieves, and the reverse always aggravates the symptoms; consequently "suggestion" is not the source of the relief. Adverse "suggestion" and ridicule from those unfamiliar with the philosophy of this subject have exerted their fullest influence in discouraging patients and counteracting the favorable results. I believe and do not hesitate to say that many people have sacrificed their lives through following the advice of persons who were ignorant of the science of the subject. It is always unwise to give advice without first possessing the necessary information. We should never accept and act upon advice until we have settled in our mind the qualifications of the person giving it. Has he grounds for his claim to a superior knowledge of the matters on which he advises?

When the philosophy set forth in this work is more generally understood, it is certain to be generally practiced, and its benefits will be shared by many sufferers. For his years of labor, the author deems himself well rewarded by the results already obtained, although he looks upon these results only as the earnest of greater things to come.

GLOSSARY.

ABNORMAL INNERVATION: An excess or insufficient supply of nerve-impulse.

AFFERENT NERVE-IMPULSE: An impulse conveyed from without to the nerve-centers.

BRAIN-LEAK: A waste of nerve-force.

DEGREE: An angle equivalent to $\frac{1}{360}$ part of a circle. The prism degree mentioned in this book is equivalent to about a half degree in trigonometry.

DIFFERENTIAL TEST: A test for determining the ability of the eyes to fuse in opposition to prisms in different positions. For instance, base down before one eye and then the other, or up before one eye and then the other, noting the difference in the prism-power that can be fused for in these varying positions.

DIFFUSION TESTS: Tests that create double vision, either by the use of means calculated to lessen the natural stimuli of the eyes or by the use of prisms.

DYNAMIC CENTERS: Centers in the nervous system where nerve-force is generated and sent forth for the performance of functions.

EFFERENT NERVE-IMPULSE: An impulse that is conveyed from the nerve-centers outward.

FOGGING: Dimming the vision and stimulating the ciliary muscle to relax its tonic spasm, by the application to the eye of a convex glass.

HETEROPHORIA: Different tending of the optic axes or lines of sight.

ESOPHORIA: Inward tending of the lines of sight.

EXOPHORIA: Outward tending of the lines of sight.

HYPERPHORIA: Upward tending of the lines of sight.

CATAPHORIA } : Downward tending of the lines of sight.
HYPOPHORIA }

HORIZONTALIZE: To fix the eyes so that the lines of sight will fall in a horizontal plane.

INNERVATION: The act of furnishing nerve-force.

LATENT EYE-STRAIN: Eye-muscle defects that are hidden and not discoverable by diffusion tests.

MANIFEST EYE-STRAIN: Eye-muscle defects which are at once discovered by diffusion tests.

METASTASIS: The change of a disease from one part of the body to another.

MOTIVE-FORCE: Nerve-impulse or nerve-force, which is the dynamic force in the performance of function.

MYDRIATIC: A drug that dilates the pupil and relaxes the ciliary muscle of the eye.

NEURASTHENIA: An insufficient supply of nerve-force.

NEUROSTHENIA: An irritant or excessive supply of nerve-force.

ORTHOPHORIA: Regular or correct tending of the optic axes or lines of sight.

PARANOIA: Insanity in which the acts are systematized.

POLARITY: The quality by which a body exhibits the power to attract and repel.

REPRESSION: The abatement of an excessive nerve-impulse, accomplished by reversing a strain.

REVERSE MANIFEST EYE-STRAIN: A strain that turns an eye in the direction opposite to the muscle that is too short.

TRAUMATIC: Pertaining to injuries or wounds.

VERTICALIZE: To fix the eyes so that the lines of sight will fall in a vertical plane.

ZYMOTIC: Pertaining to the deleterious effects of microbes, as in producing disease.

INDEX.

Abnormal innervation, 26-27; causes diseases of the eye, 43.
Accommodation, broken down, 142.
Accommodation, 153.
Action of medicines, 56.
Advancement of the ocular muscles a new operation, 189.
Advance medical science, 8.
Alcoholism, cure for, 49-53.
Alterations of function are all primarily central in the nervous system, 19.
Anatomical location of nerve-centers, 20-21, 35.
Apparent defects, 177-178.
Art gallery and sight seeing excites the nerve-centers, 24.
Assimilation, 19-20.
Asthma, 48.
Astigmatism, 151-152.
Atom of the body, every, has some office, 17-19.
Atrophy of the optic nerves and general debility. Case XVI, 113.

Before operating, 182.
Belief in long established theories quite natural, 16.
Blood simply a carrier, 20.
Bronchitis, chronic. Case XIV, 109.

Cataphoria and hyperphoria, 178.
Cataract, 43.
Catarrh, 48, 59.
Cathartic a, acts on the nerve centers, 61-62.
Caution in testing, 135-136.
Ciliary muscle, 137.
Constipation a nerve-center derangement, 61.
Consumption, 64. Case X, 104; case XI, 105; case XII, 107; case XIV, 110-111.
Correction of manifest defects gives only temporary relief, 185-188.
Correlation, 153-154.
Critic, a, 7.

Danger lies in the eyes remaining in that abnormally balanced condition that is threatening life. Case IV, 95.
Deafness, ovaritis and general debility. Case XX, 125.
Defect in one muscle sometimes hides defects in others, 99.
Diabetes, 47. Case V, 95; case VII, 98; case XVII, 114.
Development of the ocular muscles, 174-176.
Differential test, 156-158.
Diffusion tests, 167-170.
Disease, causes of, 5, 65-67; immunity from, 44-46; we do not inherit disease, 64; diseases of the eye due to abnormal innervation, 43; disease is localized nervous derangement, 46; disease and health, 40.
Distances, judgment of, 153-154.
Double vision after tenotomies, 185.

Effect, every, has a cause, 23, 61.
Endurance of various nerve-centers, 33-34.
Epilepsy. Case VIII, 99.
Esophoria, 174-177.
Excitement emphasizes functions, 18.

Experience in old methods of no value in formulating opinions of new methods, 8.
Exophoria, 177.
Eye muscles, 68; complex arrangement of, 69; physiology of the, 171, 173; why defects in the eye muscles are so deeply hidden, 75-76; defects in the eye muscles locked together, 154-155.
Eye-strain, evidence of the universality of, 70-76, 130.
Eye-strain, latent, often causes nervous derangement, 43; repressive, 132.
Eye-strain, manifest, causes little disturbance, 133-134.
Eyes of new-born infants, 71.
Eyes of the dead, 72.
Eyes of the dipsomaniac after death, 73-74.
Eyes that perform perfect vision may have serious defects, 70.

Feeling is all in the nerve-centers, 55.
Five senses, the, are feelings, 33.
Fogging, 141-142, also 155-164; sometimes induces sleep, 142-143.
Function, every, is performed by nerve or motive impulse, 17.
Function, normal or abnormal, is characterized by the nature of the nerve-impulse, 21-23, 45; functions are emphasized under excitement, 18.
Functional disturbances, continued, result in organic disease, 55.
Function, character of, depends on the character of nerve force supply, 21-22.
Fusion, 35-39; 135.

Glaucoma, 43.
Growth and formation of all parts of the body are influenced by a person's surroundings, 28-34.
Growth of tumors, 41, 55.
Gymnastic exercises of the ocular muscles, 131.

Hay fever, 48.
Health and disease, 40.
Health may continue to improve for years, 78.
Health must be carefully guarded when restored, 78.
Homœopathic principle, 56.
Horizontalizing tendency and verticalizing tendency, 35-39.
Hypermetrophia, manifest and latent, 137-139; functional manifest, 138; non-functional manifest, 138.
Hyperphoria and cataphoria, 178.
Hypnotic phenomena, the force that produces the, 195, 207.

Immunity from disease, 44-46.
Imperfect structure co-existent with perfect vision, 9-14.
Inflammation, 53.
Insanity. Case XIX, 116.
Intent of this work, 42.

Judgment of distance, 153-154.
Just estimate can be arrived at only by perusing all the pages, 8.

Latent muscular defect. Case III, 87.
Laws of refraction in an advanced state, 9.
Lesion, a, is always a result and not a cause, 41, 60.

Medicines, action of, 56.
Mental suggestion 14-15, 195, 207.
Metastasis, 53-54.
Microbe theory, 44-46.
Motor ataxy, 65. Case VI, 96.
Muscular defects, how they manifest themselves. Case I, 79; partly manifest, case II, 81; latent, case III, 87; manifest muscle defects more common in the lateral muscles, 167, 178; muscle defects may be entirely latent to diffusion tests, 42.
Muscular weakness, 129.

Mydriatics—hyoscyamine, atropine and their congeners, 139.
Myopia takes its origin as hypermetropia, 143-151; its probable cause and how to guard against it, 149-151.

Names of diseases, 46-48.
Negligence, evidence of, 102.
Nerve-center, each, is intimately connected with all other nerve-centers, 27.
Nerve-centers, 20-21; anatomical location of, 35; what part of the nerve-centers has the greatest influence, 28-29.
Nerve-centers compared with the electric dynamo, 25.
Nerve-impulses, afferent and efferent, 58, 63-64; the prime mover in all functions, 42; obstinacy of established nerve-impulse, 78.
Nerves supplying the ocular muscles, 171.
Nerve transplantation, 63.
Nerves are passive and without feeling, 48-49.
Nervous derangement often the result of eye-strain that is entirely latent, 43.
Neurosthenia and neurasthenia, 26.
New correlation, 76, 78.
New methods produce new results, 7.
Number of degrees of deviation in the optic axes can never determine the amount of eye-strain, 133.

Obstinacy of established nerve-impulse, 78.
Ocular muscles, relative strength of, 129; advancement of, a new operation, 189; gymnastic exercise of the, 131.
Offer of clinical demonstrations, 8-9.
Optic axes, 35-39; why they deviate, 129.
Organic disease the result of continued functional disturbance, 55.
Organic products depend on the nature of the nerve-impulses, 63.
Orthophoria, relative and individual, 165.
Ovaritis, 54, 60-61.
Ovaritis and diabetes. Case III, 87; case IV, 91.
Over-develop, can we, a muscular defect, 180.

Paralysis and complete loss of mind. Case XVIII, 115.
Paralysis, cure of. Case IX, 102.
Paresis, 129.
Part of the body, every, is like an engine, 17-18.
Perfect brain, a, its tendency is to a perfect body and a perfect life, 73.
Perfect pair of eyes, not one in a hundred, 69-70.
Perfect vision under serious eye defects, 178-179.
Positions of the head, 181.
Power of the eye to hide defects, 74-75.
Physiology of the eye muscles, 171, 173.

Reflex and reflex diseases, 58-59.
Relief of pain is no evidence of cure, 76-77.
Repressing abnormal innervation differs from the correction of muscular insufficiency, 13.
Repression, 145, 158-164.
Repressive eye-strain, 132.
Reverse manifestation, 12. Case IV, 91.

Secondary reflexes, 65.
Shaking palsy. Case XV., 112.
Shortening of the stretched muscle after operation, 184.
Sight awakens a feeling of all the other senses, 30-31; is an active function requiring vital energy or nerve-force, 24-25.
Sight, taste, smell and hearing, 29-31.

Stretched muscles are undeveloped, 153, 183-184.
Suggestive mental poison, 207.
Symptom tests, 161-162.
Systemic depressants and stimulants, their influence, 139.

Tabulated clinics, 126-128.
Tendency of a perfect brain is to a perfect body and a perfect life, 73.
Too much light is injurious, 31-32.
Transplantation of nerves, 63.
Tumors, growth of, 41, 55.

Verticalizing tendency and horizontalizing tendency, 35-39.
Visual centers, 35-37; they are the most sensitive, 34.

We do not inherit disease, 64.
What part of the nerve-centers has the greatest influence, 28-29.
Why defects in the eye-muscles are so deeply hidden, 75-76, 80; locked together, 154-155.
Why man and wife grow to look alike, 28.

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